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EXECUTIVE SUMMARY AND SUPPLEMENT

Preliminary
Regional

ENVIRONMENTAL
ANALYSIS
RECORD

POTASH LEASING in SOUTHEASTERN NEW MEXICO



U. S. Department of the Interior
Bureau of Land Management
New Mexico State Office

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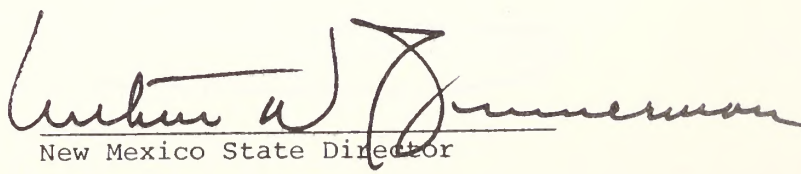
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Executive Summary and Supplement
to Preliminary Potash EAR

Prepared by
Bureau of Land Management
New Mexico
1976


New Mexico State Director

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PREFACE

In December, 1975, the Bureau of Land Management completed and distributed the 900 page Preliminary Regional Environmental Analysis Record on Potash Leasing in Southeastern New Mexico. Approximately 250 copies were printed and distributed to various governmental agencies, industrial and environmental organizations, potash interest groups and individuals. Extensive public review was made of the document and numerous written comments were received. Further public participation was solicited and received at two informal conferences and two formal public meetings held in January, 1976.

The purpose of this Executive Summary and Supplement is to provide, in conjunction with the Regional EAR, the "final" environmental report on the proposals concerning the potash industry. There were several reasons for this method of approach and format for this final report. These include:

1. The urgency to resume suspended actions concerning the issuing of permits, granting of leases, etc.
2. The minimal environmental impacts which would result from resuming the processing of the suspended actions.
3. The possible loss of potash ore due to delays in processing suspended actions.
4. The general consensus of opinion from the oral and written comments that the Regional EAR was complete, comprehensive, accurate, and adequately described the environmental consequences of the "proposed action."
5. The implementation of long-term planning, and study efforts to resolve the major problems raised in the EAR concerning air and water quality, oil and gas conflicts with potash development, etc.

For these reasons, it was determined that the time delay and high cost involved in rewriting and reprinting the entire report into a "final" was not justified. In addition, the comments received were not of the type which require substantive corrections in the text of the report. The minor changes that were requested would not have any appreciable bearing on the decision-making process.

There was, however, one section of the Regional EAR which received numerous comments recommending revision. This important section, Mitigating Measures, has been revised and is included, in its entirety, in this supplement. Also, due to its dependency on the Mitigating Measures section, the Residual Impacts section has been revised and is included in this supplement.

Since individual copies of the Regional EAR are no longer available for distribution, this Executive Summary and Supplement includes a comprehensive summary of the EAR. A summary of the public comments received in writing and those received orally at the public meetings is also included. In addition to these summary sections and the revised sections mentioned above, this document contains supplemental information, in the form of Responses to Comments, on the following subjects: the oil and gas vs. potash development conflict, the Maroon Cliffs, alternatives to the proposed actions, radio-active waste, air quality, water quality, and socio-economic impacts. The final section of this supplement details minor text changes to be made to the Regional EAR.

Reference copies of the Preliminary Regional Environmental Analysis Record on Potash Leasing in Southeastern New Mexico are located in the following places:

Bureau of Land Management
New Mexico State Office - Public Room
Santa Fe, New Mexico

Bureau of Land Management District Offices
in Albuquerque, New Mexico,
Socorro, New Mexico,
Roswell, New Mexico,
and Las Cruces, New Mexico

Carlsbad Municipal Library
Halagueno Park
Carlsbad, New Mexico

Hobbs City Library
509 North Shipp
Hobbs, New Mexico

Albuquerque City Library
423 Central Ave., N.E.
Albuquerque, New Mexico

A volume containing all written comments and transcripts of all oral comments is available for reference use at the above mentioned locations.

SUMMARY OF
POTASH ENVIRONMENTAL ANALYSIS REPORT

The Bureau of Land Management proposes to resume processing of potash lease and prospecting applications in southeastern New Mexico.

The proposal is based on a preliminary analysis of environmental impacts produced to date and anticipated to be produced in the next 20 years by the potash industry in that area.

Applications have been held in abeyance since April, 1974, when preparation of a preliminary Environmental Analysis Record (EAR) was commenced in compliance with Bureau policy pertaining to the National Environmental Policy Act (NEPA) of 1969.

The overall objective in the project is to make potash available for fertilizer and other uses in this country and abroad, while meeting the Bureau's obligation to protect the environment.

The pending potash development applications apply to 613,200 acres in the 969,875-acre potash Study Area in New Mexico's Eddy and Lea Counties.

Approximately 533,500 acres, or about 87 percent of the acreage upon which various actions have been sought, are the object of potash prospecting permit applications. The remainder of the applied-for acreage involves leases.

The following are proposed actions, including those planned or anticipated, which are on file with the BLM:

- 1) 36 lease readjustments covering 52,700 acres

- 2) 1 non-competitive potash lease application covering 800 acres
- 3) 16 competitive potash lease applications covering 26,200 acres
- 4) 226 potash prospecting permit applications covering approximately 533,500 acres

The potash companies have, in addition, certain long range plans which would result in new or adjusted mining and reclamation plans. These plans would be submitted to the U. S. Geological Survey and would require BLM approval.

Of the 969,875 acres in the Study Area, 717,276 acres are national resource lands under BLM jurisdiction. The State of New Mexico owns 167,809 acres of land which in some cases is checkerboarded among the national resource lands in the Study Area.

In addition, there are 84,110 acres of privately-owned lands, plus 680 acres withdrawn for the Energy Research and Development Administration's Project Gnome.

Present estimates are that 3.6 billion tons of potash ore exists in beds 4 feet thick or more, containing at least 10 percent K_2O equivalent. These identified reserves would last for about 210 years at the present rate of production.

If all pending applications were granted and all pending proposed actions were carried out, it is estimated that the existing production of about 2,300,000 tons of finished product (K_2O equivalent) per year would be nearly doubled in the next 20 years.

At the foreseeable maximum production rate of some 4,000,000 tons of finished product per year, the reserves identified to date would last about 110 years.

Existing Operations

The existing potash operations are located roughly 15 to 25 miles east and north of Carlsbad, N. M., a city of approximately 25,000 population.

The Study Area itself lies east of Carlsbad in an irregularly shaped tract of land ranging up to about 45 miles long on a north-south basis and from 21 to 36 miles wide east and west.

The region is semiarid.

Active potash companies at this time are Mississippi Chemical Corporation, Potash Company of America, International Minerals and Chemical Corporation, Duval Corporation, Amax Chemical Corporation, National Potash Company, and Kerr-McGee Chemical Corporation.

The seven companies are utilizing 4,025 surface acres, or 4/10 of one percent of the Study Area. Land requirements of the proposed additional operations are expected to fall within the same general requirements, approximately doubling the utilized area to 8,000 surface acres.

The environmental impacts were analyzed on the basis of addition of up to six new potash mines and up to 7 new refineries during the 20-year period covered in the EAR.

In addition to the consideration of effects from granting of the proposed actions, the EAR also took into consideration potential alternative actions.

Another factor in the overall equation is a set of possible mitigating measures, developed as possible tools to protect the environment and at the same time make the proposed action acceptable in keeping with the responsibility to provide for the orderly development of mineral resources on national resource land.

It should be noted at this point that the BLM is not proposing any of the alternative actions analyzed in compliance with Bureau obligations under law and regulations.

The seven companies operate around the clock in the Carlsbad potash Study Area and together produce all the potash originating in New Mexico.

Along with the Kerr-McGee operations at Searles Lake, California, they account for about 92 percent of the potash produced in the United States. The other 8 percent comes from Utah and Michigan.

While the Carlsbad potash production is used principally in the manufacture of fertilizer, sylvite refined to a high state of purity is used in the manufacturing and chemical industries to make hundreds of products, including glass, explosives, pharmaceuticals, soaps, etc.

New Mexico potash production was severely cut back in the late 1960s when low-priced Canadian imports started moving into the U. S. market. Subsequent U. S. import duties, followed by a rise in Canadian potash prices, reinstated the New Mexico potash industry to a competitive footing with Canadian sources.

By 1973, the New Mexico operations had increased their production to 3,960,000 tons of salts, equivalent to 2,250,000 tons of potassium oxide.

The long range outlook for the potash industry in New Mexico appears to be favorable because of a strong demand for fertilizer to meet the growing world food shortage.

During the 40 years of major activity in southeastern New Mexico's potash fields, the potash industry has grown to the point that it currently employs about 2,800 persons and provides a payroll averaging, as of 1974, about \$11,100 per employee annually--or more than \$31 million a year.

Additional employment is induced in supportive activities.

Existing Environment

The climate in the potash area is classed as semiarid continental with rainfall averaging about 12 inches annually in the Carlsbad area. Summers are warm with daytime high temperatures in the 90° - 100°F. range. Winters are mild with temperatures ranging from lows of 32° or lower to highs in the 60° range. Sunshine is abundant and relative humidities low.

Ranching has constituted the primary land use, giving way in places to potash, oil and gas operations. Approximately 716,728 acres of national resource lands in the potash Study Area are under license for the grazing of cattle and sheep. Approximately 80 acres are required to support one cow.

As is common in southeastern New Mexico, the vegetation at a given location in the potash Study Area is dependent on soil characteristics at that site. The vegetation varies, moreover, with the season and with the amount and timing of rainfall.

In general, the various types of soils maintain some ground cover, which in consecutive years of above normal precipitation tends to be supplemented by perennial grass plants not present under normal precipitation conditions.

Forty-eight species of aquatic wildlife have been found in the Study Area, where many lakes and shallow ponds (playas) are high in salt content. Among these are 36 kinds of birds, 11 amphibious animals and one fish. The waterfowl tend to concentrate on those lakes and ponds containing less salt, possibly because of lack of natural food in the saltier water.

A total of 168 species of terrestrial wildlife were identified in the Study Area, including 42 mammals, 94 birds, and 31 reptiles. The mammals are mostly rodents but include larger animals which feed on them such as coyotes, bobcats, and foxes, in addition to a few antelope and

mule deer. Birds which prey on rodents are found, as well as game birds such as quail and doves.

The overall impression a visitor to the potash Study Area receives is one of broad open spaces beneath the generally blue western skies. The natural relief is provided mainly by dune fields, with the Guadalupe Mountains to the west. Refinery stack emissions create a brownish haze which frequently darkens the sky and blocks out views of the mountains. The overall Study Area rated near the top of the "C" class in scenic quality on a 1975 BLM evaluation under an A, B, C system in which "A" ranks highest in scenic quality.

The Carlsbad Caverns and Guadalupe Mountains National Parks are located near the Study Area, as are the Lincoln National Forest and the New Mexico Zoological-Botannical State Park. Sightseeing and pleasure driving rank high among recreation uses of the region, with some camping and hunting but little fishing.

Extensive archaeological sites exist throughout the potash Study Area. These have received limited examination to date, with a complete inventory currently in progress. The most numerous type of site located so far is the campsite. Sites of all kinds are expected to approximate 12 to 15 per square mile.

Impact Findings

Based on information from many sources, including analysis of impacts from the existing potash operations over the last 40 years, the more significant impacts produced by the potash industry narrow themselves down to the following:

- 1) Impacts on air quality
- 2) Impacts on water quality
- 3) Socio-economic impacts

Each of these will be dealt with briefly in turn, first on the basis of impacts to date from existing operations and then on the basis of possible impacts in the future if operations were expanded as proposed.

Various other impacts from potash activities range from highly adverse on a limited acreage or short-term basis to low or low to moderate. Salts from potash refining operations deplete or eliminate vegetative cover at the refinery location and decrease outward to a distance of approximately one-quarter mile. Some erosion and dust-blowing results from denuded soils, both in connection with the refineries and where the surface is disturbed by roads, railroad spurs and related facilities.

Vegetation is most heavily impacted near the refinery salt tailings piles and brine ponds, with salt from air emissions causing some adverse effects on nearby vegetation to a dwindling extent as distance increases from the refinery sites.

Wildlife undergoes slight impacts in limited areas, with small mammals, reptiles and invertebrates affected more than animals and birds possessing greater mobility.

Numerous archaeological sites of varying size are affected or destroyed by potash operations, and delays in oil and gas recovery result from potash mining and related operations.

Land actually occupied by potash surface installations, totalling about 4,000 acres at present and expected to double under projected developments, is removed from grazing use. The 8,000-acre total proposed over 20 years would remove grazing for about 100 cows.

1) Impacts on air quality

Existing. The primary air pollutant emissions from the 7 potash refineries are dusts (particulate). A 1972 study indicated that the emissions from 5 of the 7 potash refineries are primarily potassium chloride (KCl) dust, while the other 2 refineries also emit some langbeinite dust and potassium sulfate dust. The majority of the emissions come from the process of drying the potash.

Federal and State ambient air quality standards for particulates are currently being exceeded within the potash Study Area. Estimated potash emissions of 19,997 tons per year in 1970 Statewide data constituted 97 percent of the point source emissions in Region 5--one of 8 air quality control regions in New Mexico--and 13 percent of the Statewide point source emissions.

The potash industry was found to contribute 28 percent of the combined total of area and point emissions of particulates in Region 5 and 5 percent of combined total area and point source emissions in New Mexico. On a daily basis, it was computed that approximately 55 tons of particulates per day emanate from the potash refineries.

Particulate emissions from area sources such as unpaved roads are a major source of particulate emissions in New Mexico. In Region 5, which constitutes an area of some 23,947 square miles compared with the potash Study Area's approximate 1,514-square-mile share of that region, emissions primarily from unpaved roads have been estimated to contribute 68 percent of the total particulate emissions. The differences in dispersal and particle size complicate comparisons.

The general characteristics in the potash area are conducive to dispersion of air pollutants and the prevention of air stagnation. In most cases, particulate levels drop to Air Quality Standard levels within 5 kilometers of a refinery.

The existing refineries do not currently produce emissions of oxides of nitrogen, carbon monoxide, hydrocarbons and oxides of sulfur in quantities exceeding New Mexico and Federal ambient air quality standards for the pollutants.

The mining and refining of potash is regarded as a relatively healthy occupation, and information to date has not shown potash miners as possessing any predisposition to respiratory, cardiac, or cerebrovascular diseases.

Proposed. New facilities would have to meet new source emission standards administered by the New Mexico Environmental Improvement Agency. Permissible emissions would be established, and ground level concentrations of suspended particulates would play a role in the approval of geographic distribution of new refineries.

Specific refinery data are necessary before the intensity of the impact on a regional basis can be determined.

So far as other pollutants such as carbon monoxide and oxides of nitrogen and sulfur are concerned, while the amounts may increase slightly any new refineries would be required to provide control equipment which assures compliance with the Air Quality Standards.

Within the existing refineries, the proposed action would have no impacts on air quality. Assuming the installation in new refineries of the latest technology, the overall in-plant air quality for the potash industry would be improved on a long-term basis.

Temporary low adverse impacts on ambient air quality would result from construction activities which permitted wind erosion of dust.

2) Impacts on water quality

Existing. There are no flowing streams in the potash Study Area. Refining operations are the only phase of potash production creating any environmental impact associated with water use.

The potash industry, through its refineries, uses 12,000 acre feet of fresh water annually and discharges approximately 10,000 acre feet of water as brine effluent. This waste goes into tailings ponds which can leak.

Once in the ground, the effluent flows vertically to pollute the groundwater or brine aquifers or laterally into existing playas, converting them to more or less perennial lakes. Many of these cover less than 100 acres each.

Impacts on hydrology also result from rainwater runoff from the large piles--estimated at about 200 million tons in all--of sodium chloride, or salt, tailings adjacent to refineries. The runoff becomes brine, which is normally held within dikes, but it can seep into the local aquifers. Regional impact from this source is negligible.

The average annual precipitation for the 39 years from 1936-1974 was 13.10 inches at the Potash Company of America refinery. The number of tailings piles is limited, with the total volume of the salt tailings estimated to be growing at about 14 million tons per year.

There is no indication that the potash refineries are directly or indirectly causing brine to flow into the Pecos River, based on information collected up to the present. An analysis of the geology and hydrology of the Study Area indicates that at some undetermined time in the future the effluent brines from the potash industry could possibly seep into the river, which meanders southward near the west border of the Study Area at some spots. It would require long-term intensive studies to estimate the probability, location, timing, and volume of such possible future seepage.

The impact of adding brine to groundwater is debatable since most aquifers in the area contain poor quality (brackish) water or brine. The impact on usable groundwater probably ranges in magnitude from low to negligible.

The conversion of playas to perennial lakes, even though they contain brine, creates a habitat for wildlife, including fairy shrimp, fish, ducks, geese, and shore birds.

Proposed. Mine development and mining would have a slight adverse impact on hydrology due to penetration of some aquifers by shafts, allowing the vertical movement of water or brine among aquifers. Problems could arise in sealing mine shafts to prevent leakage.

Impacts on the water are considered low, however, because of the dominantly poor quality of the groundwater in the Study Area. On a regional basis, these impacts are deemed negligible. Surface exploration would not significantly impact hydrology.

Increasing the number of refineries would increase the number of tailings ponds and brine lakes and would probably increase pollution of underground aquifers. In view of the uncertainties of ground water hydrology in the area, the possibility exists that any increase in brine effluent might increase the chances of brine leakage into the Pecos River. These impacts would be long-term but mostly site specific.

New potash refineries would use technology similar to that currently used, indicating that new refineries would use 150 to 600 acre feet of water per 100,000 tons of product. The water would probably come from the Caprock source, already being used more rapidly than it is being replenished. This water is being depleted over a long term, but other uses contribute more to the depletion than the potash use.

Potash lease abandonment would impact water use beneficially since the water used for refinery operations would then become available for other uses. Playas maintained as lakes at present would, in the event of lease abandonment, probably begin to change back to dry playas, causing a corresponding change in wildlife habitat and aesthetics.

3) Socio-economic impacts

Existing. The potash industry in New Mexico constitutes the bulk of the industry in the United States. Socio-economic impacts of the industry's operations are felt beyond the local level.

The EAR centers on the local aspects, with Eddy and Lea Counties comprising the Socio-Economic Profile Area. The profile area covers almost 5½ million acres.

Ranching historically was the dominant activity in the potash Study Area. Mineral development, including oil and gas along with potash, has shifted economic dominance from ranching to mineral development, with resultant effects on population and social structure.

While both Eddy and Lea Counties are involved, potash has assumed a much greater role in Eddy County than in Lea. In 1965, potash accounted for more than 80 percent of Eddy County's mineral production valued at about \$140 million.

The comparative importance of the potash production in those two counties is indicated by figures showing 2,474 potash employees in Eddy County in 1970, compared with 275--or 10 percent of the total potash payroll--in Lea County.

Lea County, on the other hand, is much more heavily into oil and gas development.

Almost 80 percent of the Study Area's 1970 population lived in urban places of 2,500 people or more. Of the area's total population of 90,673, 34,612--more than a third--lived in Eddy County's Carlsbad and Artesia.

The average income for the potash industry employee in 1974 was about \$11,100 per year with a payroll exceeding \$31 million that year. Mean family income for the potash Study Area was \$9,210 in 1969, exceeding the New Mexico mean family income of \$9,193. The median income for the nearly 24,000 families in the Study Area that year was \$8,287, compared with the \$7,849 median income for the State.

Growth of the mineral-related industry in the Study Area has affected life style, which now is less strongly tied to the land and to the self-sufficiency and stability characteristics of the ranching culture.

The transient nature of much of the incoming population argues against the development of strong community ties in the affected areas of the two counties. The majority of responses from a solicitation of views from groups and organizations were favorable toward mineral development (potash) with respect to the economic impact. The major opinion expressed was that all factors were positive. Negative responses dealt with water and air pollution problems.

Present attitudes in the Study Area are overwhelmingly pro-potash development.

Proposed. Employment is projected to double in approximately the next 20 years if 7 new potash operations are built as proposed, meaning that potash employment would increase from the present 2,800 to about 5,500 in 20 years.

The existing ratio with 90 percent of the potash employment located in Eddy County and 10 percent in Lea County is expected to continue. Induced employment in secondary activities would expand accordingly, as would population.

Other anticipated impacts if the proposed action materializes include:

Personal income: An increase attributable directly to potash operations of more than \$13 million by 1980 and more than \$70 million a year by 1990-2000.

Housing: An increased demand of more than 1,400 units by 1980 and more than 7,000 units by 1990-2000.

Education: Increased student enrollment and increased teacher requirements as employment in the potash industry and in spinoff activities grew.

Impacts on lifestyle are expected to be minimal. Pro-potash development attitudes in the Study Area are expected to continue unchanged, resulting in minimal impacts in community attitudes with further development of the industry.

Alternatives

The following alternative actions were considered. They are divided into those within existing authority and those outside existing authority and requiring legislative changes.

Alternative within existing authoritya. No Action

This alternative would continue present policies, including the prohibition of new potash operations. Existing activities could continue. The final result would be the eventual shutdown of potash mines and refineries as present leases became exhausted or facilities fell into noncompetitive condition through discouragement of capital investment and lack of incentives for further development. Unemployment could result, with a shift of potash production to elsewhere in the United States or abroad. Higher potash prices might result.

b. Delayed action pending further study

This alternative would impose a moratorium on all new actions relating to leases and prospecting while the Department of the Interior gathered additional data on the impacts of potash production on air, vegetation, land, water, and animals. New lease stipulations would be developed from the new data. This approach would extend existing environmental conditions for an estimated 2 to 3 years and might reduce environmental impacts in the future to an extent which cannot be determined at this point.

c. Alternate site for proposed Mississippi Chemical Corporation mine shaft and refinery

This alternative would reject the proposed site of a new operation in the Maroon Cliffs area and would require use of an alternate site. The only alternate site which would make a significant environmental difference, in accord with BLM guidelines, is the site of the existing refinery which is already contaminated and contains a brine pond and tailings pile. The proposed new site is considered better from a geological standpoint for development of sealed brine ponds and probably would allow less leakage from brine ponds than does the existing site. Mitigating measures should make the net impacts about the same for either site, except for the loss of a unique wildlife habitat at the proposed Maroon Cliffs site, plus infringement on archaeological and scenic values.

d. Leaching and crystallization refining process

This alternative would require the use of the leaching and crystallization refining process, rather than the more generally used selective flotation refining process. Kerr-McGee Chemical Corporation is the only company which currently uses the leaching and crystallization process. The alternative would involve restrictive lease stipulation of future potash leases. Implementation would produce net environmental impacts equal to those under the proposed action, when mitigating measures were

applied, except that more natural gas would be consumed and more carbon monoxide and oxides of nitrogen would be produced.

Alternatives outside existing authority

a. Delayed action pending legislative changes

This alternative would continue the moratorium on all new actions while the Department of the Interior sought certain legislative changes, creating a delay in issuance of new leases and prospecting permits of perhaps 10 years. Legislation might authorize funding of reclamation of disturbed areas, as well as pilot plant research to determine the feasibility of various production and refining technique improvements. Eventual shutdown of the potash industry in New Mexico and accompanying unemployment impacts similar to those under the No Action and the Delayed Action Pending Further Study alternatives would probably result, exacerbated by the lengthened period of uncertainty.

b. Stop all current and prohibit all future potash operations

This alternative would involve government purchase of all existing potash rights and properties, followed by government shutdown of potash operations. This would stop not only all environmental degradation but also the potash industry itself. It would not accomplish the purpose of making potassium available for fertilizer and is not a viable alternative.

c. Immediate readjustment of all existing potash leases

This alternative would call for immediate readjustment of all existing potash leases, disregarding the 20-year adjustment increment.

Surface protection stipulations would be revised along with other lease items, with the intent being to speed mitigation of environmental impacts. This would mean that 82 existing leases would be readjusted to include mitigating measures earlier--in some cases as much as 18 years earlier--than provided under the proposed action. Further study would be needed to estimate the decrease in environmental degradation that might be produced by the alternative.

d. Export and import adjustments

This alternative would involve congressional action to develop national export and import policy on potash. By controlling the levels of potash import and export through governmental action, the New Mexico potash operations level would be regulated, with corresponding environmental impacts. While the use of this alternative might extend the life of the southeastern New Mexico potash ore reserve and reduce environmental impacts, it would mean a change to tight government control.

e. National potash policy

This alternative would call for developing a national policy directed toward more efficient use of potash and extending the life of the potash resources. This would slow the proposed expansion of the New Mexico potash industry and could be expected to reduce environmental impacts in comparison with those anticipated under the proposed action.

f. Alternate water source for potash refining

This alternative would involve securing water for refineries from sources within the potash basin. This would result in pumping water

from the brackish ground water in the basin and/or recycling refinery waste water, rather than importing fresh water from the Caprock area and the Capitan reef aquifer. This alternative is considered outside existing authority because the State Engineer of New Mexico controls authorizations for water sources. BLM could only indirectly bring about this alternative by a restrictive lease stipulation and prohibition of the authorizaion of new water pipeline rights-of-way. The net environmental impacts of this alternative cannot be determined without ascertaining many details not now available. Less fresh water would be used for refining, with related benefits, but treatment of brackish water might produce impacts of an adverse nature which outweighed the benefits derived.

Mitigating Measures

A set of mitigating measures aimed at minimizing environmental impacts in potash operations was developed during the environmental analysis process. Such measures can be incorporated as stipulations in prospecting permits, leases, lease readjustments, exploration plans, or mining and reclamation plans.

In addition, mitigating measures to correct specific problems can be applied at any time in compliance with environmental protection guidelines.

Because of the intense detail involved, the specific mitigating measures undergo exhaustive study and reexamination on a case-by-case

basis before they become final and subject to application on site. They deal generally with exploration, mining, refining, and lease abandonment activities in the potash industry and are intended to reduce, to the maximum extent practicable, the adverse environmental impacts identified in the EAR.

The specific mitigating measures under consideration have been revised and are included in this Executive Summary and Supplement to the EAR. Many are subject to further revision on a site specific environmental analysis basis.

Residual Impacts

Air

The mitigating measures recommended in connection with stack emissions, dust blowing from surface disturbance or transportation and so on, are designed to limit adverse impacts on air quality.

The actual residual--or remaining--impacts which can be expected after the application of the mitigating measures will be determined by the amount of emission control required under air emission regulations to be developed by the New Mexico Environmental Improvement Agency.

It would require reductions in emissions of particulates (dust) from several of the 7 existing potash refineries to bring the region into compliance with New Mexico ambient air quality standards.

It would require particulate emissions be cut approximately in half--from the 19,533 tons per year in 1975 to 9,794 in 1978--for the 7 refineries to meet the 30-day ambient air standard. The emissions would

have to be cut to 5,680 tons in 1978, or a 71 percent overall reduction from present emissions, to bring the refineries into compliance with the annual ambient air standard for suspended particulates. Finally, in order for them to meet the 24-hour maximum ambient air standard the present emissions level would have to be cut 91 percent from 19,533 tons of emissions per year to 1,704 tons.

In all cases, the reduction burden would rest primarily on 4 refineries, with National Potash and Kerr-McGee Chemical already in compliance and insufficient data available on Mississippi Chemical's proposed new refinery. Controls requiring compliance with the 24-hour maximum standard would require investment of funds for air pollution control more than twice the current level of expenditures for that purpose. Compliance with the 24-hour standard would also provide compliance with the 30-day and annual standards.

Residual impacts from ground level suspended particulate concentrations in the potash area would be reduced most thoroughly by use of controls to meet the 24-hour maximum standard. The gaseous air pollutants are less plentiful in refinery emissions and are not considered to be critical air pollutants in the potash area. The EIA possesses adequate authority to ensure that any new potash refineries are equipped to meet ambient air standards.

Water

The mitigating measures which deal with drill holes, wells, shaft sealing, brine ponds, tailings piles, and research are designed to limit adverse impacts on water quality and supplies.

Some residual impacts would remain after application of the recommended measures.

Ground water supplies would be used and the Ogallala aquifer depleted to the extent that it would not be recharged. Refinery tailings ponds would leak effluent even after sealed, with the effect determined by the quality of the ground water contaminated by the leakage. Salt playas would grow in area with the sealing of all tailings ponds, since 1 cubic foot of salt is deposited with the evaporation of 5 cubic feet of saturated brine. An undetermined amount of brine runoff would occur. Lease abandonment would release water for other uses and decrease the risk of polluting the Pecos River.

Land

The mitigating measures recommended in connection with surface disturbance, roads, landfills, tailings piles, reclamation, and salt marketing are designed to limit adverse impacts on land.

Residual impacts could remain from soil compaction caused by heavy equipment and from soil erosion from construction activity. Excessive salts could accumulate in the soils to a distance of one quarter mile or more from a refinery, depending on air emission controls.

An estimated 580 acres of soil surface would be taken up by each new refining operation. Following lease abandonment, detrimental effects would gradually reduce.

Other Resources

Other residual impacts after application of mitigating measures would include:

- * The mining of 592 million short tons of potash ore, estimated at possibly 45 percent of the higher grade potash and 16 percent of the total economically recoverable potash resource estimated to exist in the Study Area.

- * The temporary loss of 300 to 400 acres of vegetation from exploration activities and the relatively permanent loss of an estimated 580 acres of vegetation per refinery site.

- * Permanent destruction of terrestrial wildlife habitat on 500 acres at each refinery site. Though long term, this would be of minimal regional significance.

- * The loss of aquatic habitat through reduction or elimination of leakage from brine ponds.

- * The permanent loss of approximately 3,500 acres of land to recreational use through their use as tailings disposal sites, partly offset by availability of new roads for hunter access.

- * Loss of the site context in archaeological excavations.

* Probable continued delays in oil and gas testing and production, combined with the necessity to use directional drilling in the potash Study Area.

* Impacts on the economic base and social structure would continue unchanged by the mitigating measures.

SUMMARY OF
PUBLIC COMMENTS

Draft copies of the Preliminary Regional Environmental Analysis Record relating to potash leasing in southeastern New Mexico were mailed to interested parties on December 6, 1975. Thereafter, comments on the Bureau of Land Management's proposal to resume processing of potash leasing and prospecting applications were solicited at four meetings in January, 1976.

The first two meetings, held January 6 and January 8, were informal conferences with environmental and potash industry representatives. Two formal meetings were held subsequently, on January 14 and January 15, for the purpose of receiving both oral and written statements from anyone who wished to appear. Thereafter, written statements were accepted through January 30, 1976.

About 660 persons attended the two formal meetings in Carlsbad and Albuquerque, approximately 80 of whom spoke. Indicative of the public interest in the matter was the personal attendance at one hearing or the other of both of New Mexico's United States Senators and one of its two U. S. Representatives, as well as the State land commissioner, State revenue commissioner, a number of State legislators and other public officials. Many of the persons who testified orally were also among the approximately 200 individuals who submitted written statements through the January 30 deadline.

Informal Meetings

An informal meeting was held on January 6, 1976, in Santa Fe at which representatives of environmental organizations were given the

opportunity to review the document with spokesmen for the governmental agencies involved in its preparation. The general reaction was favorable, with some suggestions for expanding on some points.

Bill Bishop of Albuquerque, representing the Sierra Club, called the EAR "about the best I've run across" and "amazingly complete." John Bartlitt of Los Alamos, representing the New Mexico Citizens for Clean Air and Water, said the EAR was "one of the most welldone jobs" of environmental analysis he had seen. Bishop said the question of future water supply should be expanded in the BLM analysis.

Another informal session, this time with potash company executives, was held in Carlsbad on January 8, 1976. The potash officials were in general agreement that the EAR constituted a thorough study of the subject matter, although they disagreed with some portions.

AMAX Chemical Corporation general manager Robert D. Brown said: "I want to state publicly that the alternatives will be very, very bad for this State." Dave Rice, vice president of Potash Company of America, said, "We don't completely agree with it, but we don't feel there is a great amount of controversy. We're not in total disagreement with the BLM and its objectives." General manager Jim Walls of Mississippi Chemical Company said he found the EAR "totally complete. There are areas...we need to take a look at and if we're able to resolve some of the discrepancies, we have something we can work with."

An analysis by the Potash Council, subsequently endorsed at the formal hearings by the Carlsbad Chamber of Commerce, said the EAR "seems

to cover every conceivable aspect of impact on the environment," although there were points that could be disputed. The council said no further study was justified and the BLM should proceed with its actions on pending potash applications. Concern was expressed by industry spokesmen at the informal meeting regarding both the alternatives and the mitigating measures.

Formal Meetings

The first formal meeting, on January 14 in Carlsbad, set the tone for both public sessions. One theme came across, without an exception, from those who expressed their views orally or in writing at the Carlsbad meeting and at the one which followed on January 15 in Albuquerque. Concerning the BLM's proposal to resume development of potash resources, the general consensus was:

Let's proceed.

Mayor Walter Gerrells of Carlsbad, the city closest to the rural potash area, accurately summed up the oral and written testimony at the end of the second hearing when he said:

"Mr. Chairman, you have heard loud and clear from the people of Carlsbad and the surrounding area, the people that any environmental damage would most affect. Not one person has said continue the moratorium on leasing. Not one person has said that the potash industry has caused any great environmental damage."

Support for the BLM proposal to proceed with the processing of potash leases and prospecting permit applications came, both during

and after the meetings, from spokesmen for the potash industry itself, the State Government of New Mexico, nearby city and civic entities, and residents of the area including many who rely on the potash industry for their livelihoods.

In contrast to the pro-potash unanimity registered, at the two hearings were the positions expressed in written statement submitted later by two environmental organizations and an oil-gas producer. These views will be summarized separately below.

In general, the oral and written comments of others covered much the same ground, with more detail provided in some of the written statements. Spokesmen for the potash industry itself were unanimous in urging prompt resumption of processing potash development applications that have accumulated since action was suspended pending preparation of the environmental analysis record. They cited adverse impacts on the industry, on national potash production, and on allied activities if prolonged delays should develop. They also opposed the alternatives to the proposed action listed in the EAR. Officials of the BLM made it clear at the meetings that the agency was analyzing but not advocating the particular alternatives.

A major thrust by those outside the industry centered on the economic role which it fills not only in southeastern New Mexico but in the State as a whole. Many cited figures on the economic impact which would be felt in employment and tax revenues if the potash industry were forced to curtail its operations. Others noted the importance of fertilizer, containing potassium derived from potash, in the agricultural

production of the United States and the world. They emphasized what they described as the risks of allowing the United States to become dependent of foreign producers for the bulk of her potash, likening the situation to that involving energy resources.

Speakers at the two formal public meetings generally minimized the environmental damage caused by potash mining and refining operations of the past 40 years. Some noted that the existing potash activities affect only about 4,000 acres of the potash study area which totals 970,000 acres.

The Eddy County board of commissioners pointed out "that these mines are located in an uninhabited, remote, desert area.... Commissioners Crabb, Bowman, and Means are all actively engaged in farming and ranching operations. We are aware that this area could support grazing pasture for approximately 55 to 60 head of cattle. We aren't mathematicians but we do know that the \$6,000 to \$7,000 annual income on such an operation would in no way compare to the \$35 million dollar payroll derived from this property as it is presently utilized."

Bob Boyd of the New Mexico Department of Development read into the record a statement by Gov. Jerry F. Apodaca which said:

"We are interested in protecting the land, air, and water conditions throughout the State and hope that these efforts continue. We are also most concerned about protecting a very major and important industry in New Mexico, namely the potash industry. It is essential to the State, Nation, and indeed, the world. The greatest world problem is hunger and

curtailing the production of fertilizer would jeopardize our national commitment to food production. In addition, the economic impact of the potash industry to Southeastern New Mexico is great. It has been a good industry for the State. Especially to the 2,800 employees with a payroll of \$35 million annually."

Fred O'Cheskey, Commissioner of Revenue for New Mexico, testified that the potash industry was estimated to produce direct and indirect tax revenues of approximately \$5.3 million annually for the State of New Mexico. State Land Commissioner Phil R. Lucero said State potash royalties had decreased on State lands checkerboarded among Federal lands, during preparation of the EAR, resulting in reduced income for New Mexico public schools and other State institutions. "We simply would like to see the leasing of the Federal lands commence as soon as possible in order to go on and about our own State leasing program," he said.

Representative of statements taking the position that the industry's environmental impact was an acceptable trade-off for the benefits it produced was that of U. S. Senator Joseph M. Montoya (DNM), a member of the Senate Public Works Committee's Subcommittee on Environmental Pollution and chairman of its Subcommittee on Economic Development.

"A close examination of this report reveals that no serious threat to the environment is present as a result of potash mining in New Mexico," Montoya said. "In almost every case the words 'low impact' or 'low to moderate impact' are used to describe the probable result of continued exploration and continued mining and refining of potash in this area...."

"It seems clear that the very slight environmental impact which is reported in this analysis must be balanced against the very severe economic damage which is resulting from delays in permits and against the severe economic threat which further interference and delay would pose to this community."

His colleague, U. S. Senator Pete V. Domenici (RNM), also a member of the Senate Public Works Subcommittee on Environmental Pollution, was also present at the Carlsbad meeting. Domenici noted that 95 per cent of U. S. potash consumption is for fertilizer, adding:

"A full 42 per cent of American demand for this mineral is met from domestic sources and 83 per cent of that production is from New Mexico.... What is at stake is the health of American agriculture and minimizing our dependency on foreign potash sources." He said that to make a decision without taking into account "the economic impact of potash on American agriculture and on this Nation's balance of trade, as well as the economic impact of the industry on New Mexico and Eddy County...would be an abdication of responsibility of the highest order."

The overall position of the potash companies involved was typified by Roy H. Blackman on behalf of the Potash Company of America. Interpreting the proposed BLM action as being "to get back into the business of issuing potash permits and leases," he said the company endorses it as "proper and appropriate." As for the alternatives, he said: "We at PCA find the alternatives to be impracticable and unacceptable and we object strongly to all of them."

Concerning mitigating measures outlined in the EAR, Blackman said: "Some of them we can accept without question. Others we believe can be substantially improved." Specific comments on mitigating measures, with acceptance of some and objection to others, were subsequently detailed in a written statement.

"We agree that the environment must be protected," Blackman testified. "We believe that the industry impact on the environment is now very near the attainable minimum. And we do not anticipate any serious difficulties in that area."

Among companies which expressed agreement with the position outlined by the Potash Company of America were Mississippi Chemical, National Potash Company, Kerr-McGee Chemical Corporation, Duval Corporation, Day Mines Inc., and AMAX Chemical Corporation. Robert D. Brown of AMAX Chemical Corporation said, in addition:

"It is my opinion that it is evident and apparent that there has been very, very little effect or impact on the environment. Our emissions are mainly steam and fine particles of potash that do not present a health hazard to our employees or to the general public. Also I firmly believe that there is very little effect on the plant life surrounding our refineries and I think we can prove that.

"Although there are points regarding the impacts on the environment that can be disputed by our company, the report seems to cover every conceivable aspect of impact on the environment. I feel that any further study such as an Environmental Impact Statement is not justified or

necessary. I would like to point out that most of the high grade ore in the Carlsbad basin has been mined or soon will be mined and the new leases and new prospecting permits that are applied for are going to be on marginal and low grade ore. I'd like to point out to the BLM that any unreasonable restrictions or mitigating measures could very easily make the mining of this ore uneconomical. Further delays will increase the probabilities that low grade marginal reserves that must be blended with the remaining high grade ore in our main ore zone at AMAX Chemical will be wasted."

Brown's comments, like those of Blackman, drew comments of agreement from industry spokesmen.

Hollan Cornett, staff representative of the United Steelworkers of America, said he represented the majority of the organized potash workers in Southeastern New Mexico. Stating that the union "is now and always has been very much concerned with the environment and the ecology," Cornett added: "Clean air and fresh water doesn't mean much to a man suffering from malnutrition." He said the EAR shows, in the union's opinion, that "outside of the tailings disposal area and the refinery area proper there is a very, very slight effect in the environment or the air emissions, if any...."

"If some of these prospecting permits, some of the actual mining permits are not approved in the very near future, the mining of present operations will have progressed beyond the point that the ore can be mined from the existing operations. This means that the potash ore

maintained in these areas will be unrecoverable. It will not be feasible to sink a new shaft, build a new refinery to recover this low grade, low height ore....If there is further study that must be made of the potash industry we suggest that it be made without the BLM withholding lease permits, prospecting permits or any action which would not allow the industry to continue to operate as they have in the past."

U. S. Representative Manuel Lujan Jr. (RNM), a member of the House Interior Committee's Subcommittee on Energy and Environment, testified at the Albuquerque hearing that "in some way or another, probably half of the people in Carlsbad...depend upon the potash industry for a living." Noting the large percentage of U. S. potash produced in New Mexico, Lujan said, "It would be a shame to cause a closing down or any kind of a disruption of these mines and leave us at the mercy of foreign producers. We are already at the mercy of foreign oil producers, so I would really emphasize this--we couldn't afford to be at the mercy of foreign potash producers."

Richard Hapke, representing U. S. Representative Harold Runnels (DNM) at the Carlsbad meeting, noted the importance of potash industry jobs in a time of unemployment and said, "There can be an orderly further development of the potash industry if we attempt to reach the proper balance between economic needs and matters of environment." He urged early decisions and stressed the importance Runnels attached to not placing "too many unnecessary restrictions" on the potash industry.

Among statements submitted was a telegram from Horace M. Albright, former Director of the National Park Service and former president of the U. S. Potash Company. The telegram, as read into the record by State Senator Joe Gant, said:

"Have known Carlsbad region 50 years, don't know any area where citizens and industries have been more protective of environment and yet successfully developed industry and agriculture. Resource conservation and environment policies have always guided potash enterprises. I'm very proud of public and private land use in Carlsbad region."

The environmental analysis itself drew commendation from many of those who submitted oral or written comments. Among these was the State's Environmental Improvement Agency, which said in a written statement, "we believe the EAR is well organized and presents a satisfactory analysis of the environmental impacts." They expressed the view that no Environmental Impact Statement was needed "if recommended mitigating measures are implemented." The entire process, it said, was "a productive example of Federal-State cooperation."

The State Planning Office of New Mexico said the EAR "points out a potential conflict of use in regard to the proposed Mississippi Chemical Corporation refinery site in the Maroon Cliffs area....It is important that alternative site locations be considered so as not to disrupt or lose" scenic, cultural, and wildlife values in the area of the proposed site.

The U. S. Soil Conservation Service Office in Albuquerque, based on its review, commented in a written statement: "We find that the proposed potash mining and processing activities will have little or no impact on soils, water, or vegetation which are located on private lands. Overall, it does not appear that there will be any negative environmental impacts occurring off-site."

The Southeastern New Mexico Economic Development District, and A-95 review clearinghouse, followed up testimony at the hearings with a statement saying, "This extensive effort should more than fulfill the requirements of the National Environmental Policy Act of 1969." It expressed agreement "with the general conclusion of the report that indicates environmental impacts from industry activities are not substantial....The industry's impact on the quality of life in Southeastern New Mexico is almost solely measured in terms of economic considerations."

In contrast with the pro-potash development views set forth in all oral statements at the two formal meetings and in nearly all written comments during and following the meetings were the positions taken by two environmental groups and an independent oil-gas producer in their written statements during the interval the record was kept open.

The environmental groups both called for an Environmental Impact Statement treatment, rather than reliance upon the Environmental Analysis Record as the basis for making a decision on lifting the potash development moratorium. The oil-gas producer called for detailed study of

competing needs for potash production, on one hand, and oil and gas development, on the other, within the 970,000-acre study area.

The environmental statement route was advocated in strong terms by the Natural Resources Defense Council, Inc., headquartered at Palo Alto, California, as well as by the Rio Grande chapter of the Sierra Club, Santa Fe, New Mexico. While the former said the BLM should revise the EAR or prepare a new one, following up with a detailed Environmental Impact Statement, the Sierra Club unit called the preliminary EAR "impressive" and "perhaps the best example we've seen of what an environmental analysis should be. However, in spite of the excellence of the EAR, the Rio Grande Chapter feels compelled to seek the full Environmental Impact Statement process."

Attorney P. M. Schenckan of Houston, Texas, submitted a written statement on behalf of the Belco Petroleum Corporation which maintained that the EAR not only should contain but "indeed should largely have consisted of" a mineral resource inventory comparing potash and oil-gas resources in the study area. Saying "the proposed action would seriously impede oil and gas exploration and development in literally hundreds of thousands of acres," the company said there is "an obligation" to consider an additional alternative: that of granting potash lease and prospecting permit applications "only where geological information indicates relatively high potential of good commercial potash ore and relatively low potential oil and gas."

Charles A. Feezer, attorney for AMAX Chemical Corporation, elaborated his oral testimony with a written statement following the meetings:

"My 25-year familiarity with the operations lead me to believe that appearances, not withstanding, neither air quality nor water quality within the study area of 970 M acres, of which only .41% comprises the actual mine, mill and refinery sites, have in any appreciable way damaged the environment when weighed against the massive benefits proven and reported by one witness after another at your public meetings."

MITIGATING MEASURES

This section discusses mitigating measures developed through environmental analysis. The measures are designed to minimize or prevent environmental degradation occurring from potash operations.

The mitigating measures are presented in four sections. The first section contains mitigating measures which are recommended for implementation by the permittee or lessee.

The second section contains mitigating measures which are highly recommended; however, they are not considered to be the type of action which would normally be required of a permittee or lessee. These mitigating measures will have general benefits and will require the cooperative efforts of the potash industry and several levels of government. It must be kept in mind that these mitigating measures can only be carried out if the necessary levels of cooperation, manpower, funding, and program emphasis can be obtained. To some extent many of these measures are being implemented at this time; however, they are presented here because it is believed that additional efforts along these lines would be very beneficial.

The third section of mitigating measures covers measures which may be possible, but they are not recommended due to the rationale set forth immediately following each measure.

The fourth section of mitigating measures covers items dealing with health and safety within the potash industry. These are considered desirable; however, they are outside the authority of the BLM and GS and fall within the specific responsibility of MESA.

It is the intention of the Department of Interior to make the mitigating measures applicable to existing or new operations as stated in each measure. Measures that apply to new operations can be implemented through the permittee/lessee agreeing to certain stipulations at

the time the permit/lease is issued or the measure can be made a requirement for approval of an exploration plan or mining and reclamation plan.

Mitigating measures related to existing operations can be implemented through the lessee agreeing to certain stipulations at the time a new lease, which is tied to existing operations, is issued and at the time the lease is readjusted. Also, mitigating measures can be implemented on existing operations if they fall within environmental protection regulations (30 CFR Part 231).

The decision of where each mitigating measure will be applied will be made through preparation of a site specific Part 23 technical examination and environmental analysis record on each permit/lease application and lease readjustment and an environmental impact analysis on each exploration plan and mining and reclamation plan. See Figure 1-14 of the EAR for a flowchart on potash leasing and mining and reclamation plan procedures.

In certain situations, the mitigating measures will be stipulations on leases or permits. In other situations they will be performance criteria against which company plans will be evaluated.

Mitigating measures for leases, permits, exploration plans, mining and reclamation plans and rights-of-way.

A. Air Quality

1. Existing potash refineries will be required to install reasonably available control technology such as is necessary to comply with emission limitations prescribed by the New Mexico Environmental Improvement Board (EIB). Control technology

Mitigating Measures

will be installed within a time limit to be prescribed by EIB and approved by the Environmental Protection Agency. Should EIB fail to promulgate regulations by July 1, 1978, or if the regulations are not satisfactory to the Department of Interior (DOI), the DOI reserves the right to set reasonable standards as it determines necessary including the establishment of a time limit for installation of control technology.

2. New potash refineries will be required to meet the emission limitations prescribed by the New Mexico Environmental Improvement Board or a Federal new source performance standard.
3. The lessee will transport waste material removed to develop a mine and transport and store ore and finished product in a manner which controls fugitive dust in accordance with New Mexico EIA specifications.

B. Water Quality

1. The lessee shall provide measurements as specified by the Environmental Improvement Agency (EIA) of the amount and quality of water flowing into existing or new refineries and the amount and quality of water or brine flowing from existing or new refineries.
2. Prior to siting and construction of new or significantly expanded brine ponds the lessee shall conduct geologic and hydrologic studies of the area and demonstrate design adequacy to prevent environmental pollution through seepage or flooding. Design features must meet the standards prescribed by regulations of the New Mexico Water Quality Control Commission (WQCC).

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Should the WQCC fail to promulgate regulations by the time new brine ponds are being proposed, or if the regulations are not satisfactory to the DOI, then the Department of Interior reserves the right to require such sealing as it deems necessary.

Further, the lessee shall demonstrate that management of new tailings piles and brine ponds provides for desired evaporation while minimizing the area to be covered by tailings piles and brine ponds.

3. If through the water quality monitoring studies it is determined that existing potash refinery effluents are polluting valuable water, then the lessee shall take action to seal the sources of pollution or employ other appropriate means to comply with regulations of the Water Quality Control Commission (WQCC). Should the WQCC fail to promulgate regulations by July 1, 1978, or if the regulations are not satisfactory to the Department of Interior (DOI), then DOI reserves the right to set reasonable standards and require reasonable mitigating measures as it deems necessary.

The lessee shall make every reasonable effort to manage existing tailings piles and brine ponds so as to provide for desired evaporation while minimizing the area covered by tailings piles and brine ponds.

4. The lessee or permittee may be required to convert certain potash exploration drill holes into water or brine observation wells providing such conversion does not interfere with the

Mitigating Measures

- lessees' or permittees' normal operations. The conversion will be done in a manner approved by the Area Mining Supervisor and the lessee or permittee will be reimbursed for the cost of conversion which exceeds the normal cost of abandonment of the well. The government will assume the responsibility for subsequent proper plugging and abandonment of the well.
5. Drill holes will be properly sealed through water-bearing aquifers according to applicable procedures and regulations. Shafts will be properly grouted and sealed through water-bearing aquifers. Where shaft seals cannot be made completely effective, shaft rings and/or sumps with adequate pumps will be installed where necessary and fluids will be pumped to the surface and disposed in a manner consistent with applicable procedures and regulations.

C. Surface Protection

1. The Lessee or Permittee shall minimize surface disturbance when conducting exploration and mining activities.
2. Common use corridors shall be considered when planning utility and transportation facilities, and existing roads shall be used whenever practical.
3. The lessee shall demonstrate the design adequacy of proposed roads (including culverts, bridges, turnouts, ditches, and waterbars) prior to construction. The Area Mining Supervisor and authorized officer (BLM) may require reclamation of roadways constructed by the lessee at the time such roadways are abandoned or not used by the lessee.

Mitigating Measures

4. Topsoil will be stockpiled and replaced on disturbed areas in a manner provided by the approved Exploration or Mining and Reclamation Plan.
5. Where excavation is required for support facilities, all trenches will be backfilled, and a berm will be left on top of the backfill adequate to compensate for settling.
6. Leased lands shall be abandoned only after the conditions and terms of applicable exploration plans and mining and reclamation plans have been complied with and the lands have been rehabilitated and reclaimed to the satisfaction of the Area Mining Supervisor and the authorized officer (BLM).

D. Resource Conservation

1. Wherever practical and without causing any safety hazard or violation of any MESA requirements, the lessee shall locate mines, refineries and all support facilities (roads, highways, pipelines) such that the pillar necessary to support the operation does not infringe upon the potash ore deposit.
2. Where mineable ore is located under refinery facilities and when these facilities are removed, the lessee shall make the maximum practical effort to remove the ore.

E. Wildlife and Archaeology

1. The lessee shall allow the government to tap waterlines to provide small quantities of water for wildlife drinking facilities.
2. Removal of trees which are used now or could be used in the future for raptor nesting or perching will be avoided. If alternatives are not feasible, mitigation measures will include the replacement of trees. The kind, number, survival rate and location of which will be determined by the District Manager (BLM) and Area Mining Supervisor (USGS).
3. The location of facilities within 300 yards of tree groves or other known raptor nesting areas will be avoided. If alternatives are not feasible, mitigation in the form of habitat replacement of comparable value will be required. This mitigation may be in the form of man-made structures or replacement tree plantings at the discretion of the District Manager (BLM) and Area Mining Supervisor (USGS).
4. If bird electrocutions become a problem on segments or specific poles of existing transmission or distribution lines, modifications of the poles will be made according to specifications in R.E.A. Bulletin 61-10. Such modifications will be made without liability or expense to the United States. All new powerlines will conform to specifications in R.E.A. Bulletin 61-10.

Mitigating Measures

5. When powerlines are abandoned, the BLM will designate the poles that should remain in place for use by raptors and other large birds.
6. The lessee shall demonstrate that the proposed location of mine shafts, refineries, tailings piles and brine ponds minimize the impact on wildlife, natural lakes and playas and cultural resources or that the benefits of a specific site outweigh the environmental impacts with mitigation.
7. Prior to any surface disturbing activities the lessee shall have a qualified archaeologist acceptable to the Authorized Officer (District Manager, BLM) and Area Mining Supervisor, USGS, conduct an archaeological survey of the area to be disturbed.
8. The Authorized Officer (District Manager) and the Area Mining Supervisor retain the prerogative to require the relocation of proposed facilities to protect archaeological values located on the permitted/leased lands, or they may require the lessee to have the archaeological site(s) excavated and salvaged by a qualified archaeologist(s) prior to proceeding with operations. The decision to relocate or salvage shall be consistent with conservation of mineral resources.

F. General Environmental Quality

1. The lessee shall demonstrate that the principles of landscape architecture as guided by the BLM Visual Resource Management

Mitigating Measures

System have been applied in planning and designing new mining and refining, tailings piles and support facilities. The lessee shall submit appropriate drawings as part of the mining plan for written approval by the Area Mining Supervisor.

2. The lessee or Permittee shall transport all refuse to landfills which are in compliance with the State of New Mexico's Solid Waste Management Regulations.
3. The lessor reserves the right in new or readjusted leases to add reasonable future environmental stipulations at reasonable time intervals to protect resources including but not limited to the surface estate and groundwater quality.
4. The lessee will comply with all reasonable regulations of the Secretary of the Interior now or hereafter in force when not inconsistent with any expressed or specific provision of the permit/lease.

Mitigating measures of a general nature requiring the cooperation of industry and government.

1. An interpretive facility should be provided to explain to the public what the industry is and why it is necessary. An appropriate location would be along U. S. Highway 62-180.
2. Initiate an air quality monitoring program for the potash Study Area.

Mitigating Measures

3. An intergovernmental research study in which industry will be encouraged to participate will be conducted to determine more specifically the environmental effects of slimes, solid salt, and brine tailings and develop ameliorating procedures. The study will include a long term monitoring program of aquifers and water movement to determine the extent and effects of waste water percolation into aquifers. The BLM has budgeted two positions and \$50,000 in FY 77 to initiate the study. In addition, the EIA is planning to allocate some of the Section 208 (Federal Water Pollution Control Act of 1972) funds for the study.
4. Conduct research to find new or improved methods of refining and brine disposal to reduce the consumption of water.
5. Initiate a new hydrologic study of Anderson Lake and Laguna Grande de la Sal.
6. A comprehensive plan for a mineral resource inventory and simultaneous or sequential development of potash and oil/gas yield should be formulated in order to minimize environmental impacts and maximize yields.
7. Conduct research into improved mining techniques to increase recovery of additional ore.
8. Create an adjustable royalty procedure based on potash ore grade and overriding royalty to provide incentive to use lower grade ore.

Mitigating Measures

9. Studies should be made to determine the most feasible method of recovering potash entrained in refinery effluent and industry should be encouraged to recover it.
10. Conduct research into new or improved refining techniques to recover more potash, and possibly magnesium to reduce waste of minerals.
11. Investigate new markets for salt and encourage a freight rate structure which is more beneficial for transporting salt.
12. Conduct studies to determine the suitability and habitability of natural lakes, playas, and brine ponds to wildlife (terrestrial and aquatic) and develop ameliorating procedures.
13. If it is decided that the potash companies should monitor the environment with company personnel, a training course should be given by the appropriate government agencies on techniques of environmental monitoring. The techniques of making and reporting chemical analyses should be standardized to a reasonable extent. Those government agencies receiving the data should understand the limitations of methods used to acquire it.

Possible mitigating measures which are not recommended.

1. It has been suggested that the salt tailings could be returned underground and disposed of in the voids created by mining.

This mitigating measure is not recommended because traditionally, mine tailings are reworked once or twice to recover valuable minerals that were missed in the first or second processing.

The present method of room and pillar mining does not easily accommodate a scheme for refilling the voids left with salt tailings. If the rooms were to be refilled, the pillars probably could not be mined thus additional potash would be lost in the mining process. Moreover, the voids left are of insufficient volume to receive and store the mine tailings. Finally, this measure is economically unfeasible.

2. If studies show refinery effluents are polluting the Pecos River or increasing the amount of brine flow from the natural salt springs at Malaga Bend, the potash companies should pump an equivalent amount of brine from the aquifer feeding the springs at Malaga Bend into Laguna Grande de la Sal.

Many hydrologist familiar with the hydrologic problems at Malaga Bend have long advocated some variation of this mitigating measure and it is admitted that this may be a practical solution to alleviating the salinity of the Pecos River in the reach from Malaga Bend to Red Bluff Reservoir; however, there are numerous difficulties with this scheme. First, Laguna Grande de la Sal is privately owned, and it is doubtful if the owners (MCC) can be persuaded to allow additional pumpage of brine into this reservoir.

Secondly, Laguna Grande de la Sal also contains valuable archaeological sites and if used as a repository for brine the lake levels must be maintained below former high levels. It is possible that this reservoir could be used to store additional brine with little increase in reservoir level if additional salt is harvested from the lake floor.

A further reason for not recommending this measure is that if the reservoir stages were raised the lake may leak.

3. Technically it is possible to require the production of lower grade K_2O finished product so as to improve total potash recovery and consume less fresh water in the refining process.

This mitigating measure may be desirable; however, it is not within control of the Department of Interior because product quality is a function of the market.

Mitigating measures on health and safety under the specific authority of MESA.

There appears to be adequate regulations and/or authority for MESA to implement the following type of mitigating measure.

1. Conduct an extensive evaluation of in-plant and underground dust contamination levels. Provide an adequate respirator control and monitoring program.
2. Implement a noise exposure survey program and a hearing conservation program with intensive control and monitoring.

RESIDUAL IMPACTS

A revision of
pages III-97 through III-132
of the Potash Leasing EAR.

Air

The mitigating measures recommended in connection with stack emissions, dust blowing from surface disturbance or associated with transportation and so on are designed to limit adverse impacts on air quality. Several of the mitigating measures recommended seek to deal with this particular aspect. It is not possible at this point to determine the actual residual--or net remaining--impacts on air quality which would persist if these mitigating measures were applied, since air emission regulations have not yet been developed for the potash industry. The Environmental Improvement Board intends to promulgate air quality standards and, therefore, the actual residual impacts will be determined by the stringency of this regulation. With that variable in the background, this section on residual impacts presents the impacts which could be expected at three different assumed levels of air emission control:

First, control necessary to meet the 30-day ambient air standard;

Second, control necessary to meet the annual ambient air standard;

Third, control necessary to meet the 24-hour ambient air standard.

Reductions in particulate (dust) emissions from at least four of the seven existing potash refineries would be needed to bring the region into compliance with New Mexico ambient air quality standards. Table 1, Recommended Particulate Controls, summarizes the emission reductions it

would take to produce compliance with the standards for the three time periods. It would require that particulate emissions be cut approximately in half--from the 19,533 tons per year calculated in 1975 to 9,794 in 1978--for the seven refineries to meet the 30-day ambient air standard. The percentage reduction in that case, for purposes of comparison, would be 50 percent. The emissions would have to be cut to 5,680 tons in 1978, or a 71 percent overall reduction from present calculated emissions, to bring the refineries into compliance with the annual ambient air standard for suspended particulates. Finally, in order for them to meet the 24-hour maximum ambient air standard--the most stringent--the existing emissions level would have to be cut 91 percent from 19,533 tons of emissions per year to 1,704 tons.

In all cases the reduction burden--based on existing information--would fall primarily on four refineries. National Potash and Kerr-McGee Chemical are already in compliance at each level, and insufficient information is available concerning Mississippi Chemical's proposed new refinery. The following discussion presents an analysis of the residual impacts associated with achieving the three levels of reductions in particulate emissions cited.

The 30-day average standard for suspended particulates is 90 ug/m^3 , and four refineries (Duval, AMAX, PCA, and IMC) would be required to

TABLE 1 - RECOMMENDED PARTICULATE CONTROLS

Plant	To Meet Annual Standard		To Meet 30-Day Standard		To Meet 24-Hour Maximum Standard	
	1975 Emissions (tons/yr.)	Rec. % Reduction	1978 Emissions (tons/yr.)	Rec. % Reduction	1978 Emissions (tons/yr.)	1978 Emissions (tons/yr.)
National	128	0	128	0	128	128
Duval	2,660	52	1,277	9	2,421	293
AMAX	2,629	70	789	38	1,630	131
Miss Chem*	(unknown)			(unknown)		82**
Kerr-McGee	470	0	470	0	470	470
PCA	4,084	80	817	63	1,511	204
IMC	9,562	77	2,199	62	3,634	478
TOTAL	19,533		5,680		9,794	1,704
Overall % reduction	71		50		91	

*Not included since the data are not sufficient for calculation for the proposed new Mississippi Chemical Plant.

**For existing MCC Plant.

reduce particulate emissions to bring about compliance with the 30-day standard. The necessary reductions at the individual refineries are summarized in Table 1. Figure 1 shows the isoconcentration lines of suspended particulates on an annual basis around the seven refineries, with each refinery controlled to assure compliance with the 30-day standard. Although the 30-day standard could be met with this control strategy, the annual standard would still be exceeded in the vicinity of the Duval, AMAX, PCA, and IMC refineries. Furthermore, the maximum 24-hour standard would also be exceeded in event of the imposition of controls designed to meet only the 30-day standard. If the control technology for complying with the 30-day standard were put into effect, beneficial impacts would occur not only on a site-specific basis for the four refineries required to provide the additional controls but also on a regional basis, since four of the seven refineries would reduce their particulate emissions an average of 50 percent.

The overall reduction in particulate emissions needed in order to meet the annual geometric mean standard for suspended particulates in the potash area is 71 percent, somewhat greater than the 50 percent reduction necessary under the 30-day standard. The same four refineries --Duval, AMAX, PCA, and IMC-- would have to provide additional particulate emission controls to be in compliance with the annual standard.

The specific percentage and tonnage figures involved, with reductions ranging up to 80 percent from present emissions at the PCA refinery, are shown in Table 1.

Table 2 summarizes the maximum annual ground level concentrations of suspended particulates that would result by 1978 from the implementation of these additional controls. Figure 2 shows the composite analysis for all seven refineries after addition of the controls necessary to comply with annual ambient air standards. The implementation of these controls would provide beneficial impacts on a site-specific basis around the Duval, AMAX, PCA, and IMC refineries and throughout the region since the overall ambient air concentrations of suspended particulate matter would be reduced. Compliance with the annual standard would at the same time accomplish compliance with the 30-day standard, but the four refineries would continue to be in non-compliance with the 24-hour maximum standard.

If the potash refineries were to comply with the maximum 24-hour standard of 150 ug/m^3 , particulate emissions would have to be reduced more than 90 percent from their current calculated levels. The specific reductions that would become necessary for the four refineries mentioned previously--Duval, AMAX, PCA and IMC--ranging as high as 95 percent, are shown in Table 1. In addition, that table shows the percentage reduction that would be necessary for the existing Mississippi Chemical

TABLE 2 - MAXIMUM GROUND LEVEL CONCENTRATIONS
OF SUSPENDED PARTICULATES (1978 with recommended controls)

Plant	Max. Annual Ground Level Concentration ³ (ug/m ³)	
National	2.7*	(42.7)
Duval	15.0	(55.0)
AMAX	15.0	(55.0)
Miss. Chem.	(Unknown for New Plant)	
Kerr-McGee	14.7	(54.7)
PCA	15.0	(55.0)
IMC	15.0	(55.0)

*Without natural background, numbers in parentheses are with background.

refinery, in the absence of data for its proposed new refinery. As in the cases of the 30-day and annual standards, the National Potash and Kerr-McGee refineries are already in compliance and need no reductions in particulate emissions to comply with the 24-hour standard. Figures 3 through 7 show the annual geometric mean concentration of suspended particulates in the vicinity of the five refineries affected, following the implementation of the additional control technology that would be required at those refineries to produce compliance with the 24-hour standard. If controls were installed to meet the 24-hour maximum standard, investment of funds for air pollution control of more than twice the current level of expenditures for that purpose would be necessary. Compliance with the 24-hour maximum standard would simultaneously ensure compliance with the 30-day standard and the annual geometric mean standard. Imposition of controls to meet the 24-hour maximum standard would yield site-specific beneficial impacts in the vicinity of the five refineries requiring additional controls, based on the Table 1 conditions, as well as regional beneficial impacts based on the overall reductions in ground level suspended particulate concentrations.

In summary, residual impacts from ground level suspended particulate concentrations in the potash area would be reduced most heavily by use of controls designed to meet the 24-hour maximum standard. The

gaseous air pollutants are not analyzed here because they are emitted in relatively small quantities by comparison with the suspended particulate matter and are not considered to be critical air pollutants in the potash area. This analysis does not attempt to cover the one to seven proposed new potash refineries, since specific information with regard to location and the conditions of the particulate emissions is not available at this time. The EIA possesses adequate regulatory authority to ensure that new potash refineries are equipped to meet ambient air standards before they are permitted to start operations.

Water

Recommended mitigating measures which deal with drill holes, wells, shaft sealing, brine ponds, tailings piles, and research are designed to limit or eliminate adverse impacts on water quality and supplies. Many of the recommended mitigating measures seek to deal with this aspect of environmental disturbance. The residual impacts identified here are those that would remain after these mitigations were employed.

Ground water supplies would be used and the Ogallala aquifer depleted to the extent that it would not be fully recharged.

Brine would be added to the ground water or playas to the extent that refinery tailings ponds would continue to leak effluent after they were sealed. The effect of the leakage would depend upon the quality of

the ground water into which the brine leaked and the amount of fresh water normally entering the playas. The leakage might present an undetermined hazard of polluting the Pecos River, however, it is anticipated that such pollution could be controlled once it was found to be occurring.

Sealing all of the refinery tailings ponds would have an adverse impact in that additional land would be covered with salt playas. Enlargement of areas covered by playas would occur because the evaporation of 5 cubic feet of saturated brine results in the deposit of 1 cubic foot of salt. Therefore, sealing the ponds would require a considerable area to accomodate the salt deposited after evaporation.

An undetermined residual impact would result from brine runoff when rain fell on the tailings piles. This brine would be caught behind dikes, however, it might seep into the ground entering the groundwater or move laterally into nearby playas.

Lease abandonment would have residual beneficial impacts in releasing the water used by the potash industry for other uses. In addition, the risk of polluting the Pecos River should decrease when the refineries cease adding brine to the environment.

Land

Mitigating measures recommended in connection with surface disturbance, roads, landfills, tailings piles, reclamation, and salt marketing

are designed to limit or eliminate adverse impacts on land caused by potash activities. Many of the recommended mitigating measures are directed at this aspect. Residual impacts are those that would remain after the application of the proposed mitigating measures.

A minor residual impact would result from exploration. Alteration of existing drainage patterns would affect downstream and adjoining areas. Thus some areas might be deprived of available soil moisture, and therefore, normal growth of protective vegetation would be affected. Use of heavy equipment would compact the soil, altering the soil permeability and reducing infiltration rates. This would increase surface runoff, erosion, and sedimentation. The removal of surface soil and its protective vegetation for pad preparation and access roads would expose the unprotected soil area to excessive wind and water forces. Wind would blow the unprotected soil, reducing air quality and adding to soil loss. Construction activity would mix, alter and disturb the topsoil, destroying the existing microorganism community and soil-plant relationships. The soil structure in the affected locations would be altered appreciably from its present condition.

A residual impact of slight surface subsidence would result from the development of a mine site and mining. If the waste from mine development work were transported to the refinery, there would be a

minor residual impact produced by haul road construction from the mine site to the refinery, resulting in changes to existing drainage patterns. Road construction, which causes soil compaction, would alter permeability and infiltration rates, thus increasing runoff, erosion, and sedimentation.

Depending upon the effectiveness of the air emission control regulations and equipment, the construction and operation of a refinery would produce a residual impact from the accumulation of salt in the soil as a result of particulate emissions. Excessive salts in the soil deplete or eliminate protective vegetative cover, thus exposing the soils to wind and water erosion. Increased erosion, sedimentation, loss of soil and pollution of the atmosphere by particulates subsequently occurs. The accumulation of excessive salts as a result of particulate emissions may occur out to a distance of one quarter mile or more from a refinery, depending upon air emissions controls.

An estimated 580 acres of soil surface would be removed from vegetative production at each refinery site. That includes the soil areas rendered sterile beneath tailings piles and brine ponds.

Construction and use of support facilities would have residual impacts in that the topsoil along the entire route of roads and railroads would be disturbed, mixed and altered, destroying the existing

microorganism community and soil-plant relationships. This would result in the loss of protective vegetation and induce increased erosional conditions, subsequent soil loss, and reduction of air quality. Heavy equipment would compact the soil, affecting soil permeability and water infiltration rates and resulting in increased runoff, erosion, and sedimentation. The area used for roads and for railroad track ballast slopes would be lost to soil productivity for the period of use. Support facilities such as gas lines, water lines and power lines would have basically the same residual impacts as roads and railroads, except that the term would be shorter. Once original construction was completed, recovery would occur sooner.

After lease abandonment, surface disturbances which had altered soil structure, permeability, infiltration rates, compaction properties and vegetative cover at the existing operations would be halted. When the depositing of salts ceased, a low adverse impact would continue until the detrimental effects from salt accumulation were reduced with the passage of time. After the period in which soils became readjusted, a beneficial impact would set in as an adapted vegetative community reestablished itself. This could be expected with the curtailment of refinery particulates in effluents that previously had contaminated the soils. With the discontinuance of construction disturbances, soil

surface micro-interrelationships would be allowed to readjust. Lease abandonment would reduce the impacts of roads and railroads, since these would be torn up and the area revegetated.

Minerals

Impacts of the proposed action on mineral resources would be reduced by recommended mitigating measures dealing with facility siting in relation to support pillars; removal of hoisting equipment; resource inventories; mining and refining research; lower grade ore recovery incentives; recovery of potash in refinery effluent, and salt marketing. Recommended mitigating measures seek to mitigate mineral resource impacts.

The mining and processing of potassium-bearing ores would continue if the proposed action is approved, resulting in residual impacts in the depletion of nonrenewable mineral resources. In the next 20 years, an estimated 592 million short tons of potash ore would be mined or lost in mining in the Carlsbad mining district. This tonnage comprises about 16 percent of the total economic potash resource estimated to exist in the district and may comprise up to 45 percent of that economic resource of higher grade.

Other residual impacts would include the use of aggregate in construction activities, the removal and stacking or entraining in brines of common salt associated with potash ore, and the delay or even prevention of the completion of test and development wells for oil and gas.

An undetermined amount of potash would be entrained in brines because of processing inefficiencies. Effective sealing of ponds might enrich the brine in potassium salts, with the possibility of harvesting this brine at some future date.

Vegetation

Recommended mitigating actions designed to minimize impacts on vegetation deal with air quality control, dust control, brine pond sealing, tailings piles management, tailings ponds, surface disturbance, utilities and transportation corridors, road standards, trash disposal, topsoil and lease area reclamation, trench backfilling, refinery siting, lease stipulations, water research, and salt marketing. Many of the recommended mitigations affect vegetation in the potash area. Residual impacts are those impacts that would remain after the mitigating measures were applied.

Exploration activities would cause the temporary loss of 300 to 400 acres of vegetation which would be revegetated in 1 to 5 years. Mine development would cause the relatively permanent loss of some 5 to 10 acres of vegetation per mine site. Refinery construction and operation would cause the direct, relatively permanent, loss of an estimated 580 acres of vegetation at each refinery site. In addition, refinery operation would produce a variable residual impact on an undetermined area of

vegetation resulting from refinery air emissions. This impact would range from slight discolorations of leaves through defoliation, mortality, species changes to salt tolerant vegetation, and finally to total sterilization of the soil. The area involved would depend upon the effectiveness of future air emission control regulations. The maximum area that would be involved if no air emission regulations were developed is estimated at a radius of one-quarter to one-half mile around each potash refinery. Enactment of air emission regulations would reduce the impact area by an unknown amount.

Construction and operation of refinery support facilities would cause the direct, relatively permanent, loss of an estimated additional 30 acres of vegetation and the temporary loss of an estimated 120 acres of vegetation per refinery. Lease abandonment would permit the existing air emissions and surface disturbance to cease. After that occurred, the mine site, the support facility area and all but the tailings piles and brine pond areas (500 acres) of the refinery sites should become revegetated once the toxic salt concentrations have been leached out of the active root zone for adapted vegetation.

Wildlife

Recommended mitigating actions designed to reduce or eliminate impacts on wildlife include those dealing with air quality control, dust

control, brine pond sealing, tailings piles management, tailings ponds, refinery wastes, surface disturbance, utilities and transportation corridors, road standards, trash disposal, refinery siting, lease area reclamation, wildlife water, tree controls, power lines, wildlife habitat, and water research. Recommended mitigations seek to alleviate wildlife impacts. After these measures were put into effect, the following residual impacts would remain.

Some noise disturbance and habitat destruction would continue as a by-product of exploration, mine development, refinery construction and operation and construction of support facilities. These would range from short term to long term impacts and would be slightly adverse, ceasing upon lease abandonment. Terrestrial wildlife habitat would be permanently destroyed on an estimated 500 acres at each refinery site with the establishment of tailings piles and brine ponds. This would constitute a long term adverse impact but would be of minimal regional significance. A moderately beneficial impact on the few big game species that exist in this area might continue to occur on a site-specific basis produced by a change in vegetative species to the salt resistant four wing saltbush. This is a preferred browse species. The change occurs in limited areas of particulate fallout and could continue for the operation life of a refinery.

A potential would exist for a significantly adverse impact on aquatic wildlife species if mitigating measures to reduce or eliminate leakage from brine ponds were implemented. This action could lead to the loss of aquatic habitat by eliminating the water source. It would constitute a long-term site-specific impact.

Ecological Interrelationships

Impacts on ecological interrelationships would be mitigated by measures dealing with air quality control, dust control, brine pond sealing, groundwater pollution, tailings piles, tailings ponds, refinery waste disposal, surface disturbance, utilities and transportation corridors, road standards, trash disposal, topsoil reclamation, trench backfilling, refinery siting, lease area reclamation, tree control, power lines, wildlife habitat, lease stipulations, research, and mineral resource inventorying. The mitigating measures seek to alleviate ecological impacts.

After the proposed measures were applied, there would be residual impacts from disruption during the varied construction activities. Ecological processes would be destroyed or altered to some extent wherever construction took place. The impacts from tailings piles and brine ponds would be permanent. A reduction in air emissions from the refineries would bring about some reduction in the impacts on ecological

Residual Impacts

Aesthetics and Recreation

interrelationships related to salt accumulations in the soils, the effects of air emissions on vegetation, and the corresponding effects on wildlife and soil protection.

Aesthetics and Recreation

Impacts on aesthetics, open spaces and recreation would be reduced by recommended mitigating measures dealing with air quality control, dust control, groundwater pollution, tailings piles, tailings ponds, refinery waste disposal, surface disturbance, common use corridors, trash disposal, topsoil reclamation, refinery siting, lease area reclamation, wildlife water, tree control, wildlife habitat and cultural resources, research, and salt marketing.

If mitigating measures were adopted, the residual adverse impacts from the proposed action or alternatives would consist of: The permanent loss of approximately 3,500 acres of land to recreational use through their use as tailings disposal sites; the creation of an undeterminable amount of linear scars along rights-of-ways; and the removal of new mining and refining sites from public use during their period of operation. A residual beneficial impact would result from the availability of new roads for improved hunter access and off-road vehicle use within the Study Area.

Cultural Resources

The impacts of the proposed action and alternatives on cultural resources would be reduced by implementing mitigating measures dealing with protection of cultural resources, archaeological surveys, and archaeological protection. Recommended measures deal specifically with this aspect. If they were put into effect, certain adverse residual impacts would remain.

Cultural values, even when salvaged, are sometimes destroyed. The very act of salvage often involves the destruction of the site context. The information gained is limited by the techniques currently available. The development of a better technique at a later date is of no use once the site has been excavated, since only the materials possessing present informational value are saved. The site context is gone and no further information can be gained. If, for example, a method of determining sleeping areas from soil samples were discovered in the future, it could not be applied to those sites already excavated since no soil samples would have been saved for that purpose. The residual impact is the destruction of the site, even when it was excavated by qualified archaeologists.

Avoidance of sites also involves a residual impact. Sites which are avoided by right-of-way routing are made more accessible to pot-hunters than they were before the right-of-way was constructed. Cultural resources are irreplaceable and damage is done when they are disturbed

in any manner. Lease abandonment would leave the area accessible and could mean that in some areas pothunter traffic would actually increase.

Socio-Economic Conditions

The residual impacts on the economic base and social structure would be the same, after implementation of recommended mitigating measures, as the impacts described in the EAR (page III-25 to III-36).

Land Use Compatibility and Suitability

The impacts of the proposed action or alternatives on land use compatibility and suitability would be alleviated by recommended mitigating measures dealing with air quality, dust control, water wells, brine ponds, ground water pollution, tailings piles, tailings ponds, refinery wastes, surface disturbance, utilities and transportation corridors, road standards, trash disposal, topsoil reclamation, refinery siting, lease area reclamation, refinery locations in relation to support pillars, wildlife water, tree control, power lines, wildlife habitat and cultural resources, archaeological protection, landscape architecture, lease stipulations, research, mineral resource inventorying, and salt marketing. Many of the recommended mitigating measures are directed at this aspect of environmental impact.

Probably the most significant residual impacts would fall on the oil and gas industry and on cultural resources. It is quite likely that oil and gas testing and production would be delayed or forced to employ directional drilling within the Potash Study Area. Because of the lack

Residual Impacts

Short-Term Use vs. Long-Term Productivity

of technology for drilling through mined areas, this could be a long term impact.

As for cultural resources, it would not be possible to avoid all archaeological sites within the area during surface disturbing activities because of their density. Even when a site is salvaged, its potential for yielding further information in the future is destroyed. Considering the present lack of archaeological knowledge about the area, this would constitute a significantly adverse impact of a long term nature.

B. Short-Term Use vs. Long-Term Productivity

Full-scale development of the potash industry in the Carlsbad potash Basin would not significantly reduce long-term productivity, based on present estimates that 3.6 billion tons of potash ore exists in beds four feet thick or more and containing at least 10 percent K_2O equivalent. At present, the seven operating companies produce about 2,300,000 tons of finished product (K_2O equivalent) per year. At that rate, the presently identified reserves would last for about 210 years. If this production were increased to the maximum amount foreseen at this time, about 4,000,000 tons of finished product (K_2O equivalent) would be produced annually. This would mean that the reserves identified to date would last about 110 years.

Residual Impacts

Short-Term Use vs. Long-Term Productivity

Several factors could dramatically modify the data given above. The prospects could be changed, for example, by developments in the overall economics of potash mining and refining enhancing the recovery of lower grade ores; changes in refining technology; changes in the agricultural use of potash, and other such variables. Even at the higher rates of potash production, significant acreages of land surface would not be removed from other resource uses. At present, the seven operating companies use 4,025 surface acres in the 969,875-acre Study Area, or 4/10 of one percent.

From the standpoint of productivity, the entire Study Area is currently useful for producing livestock and wildlife forage. The extent to which forage production is or would be impaired as a result of potash mining is a very small amount in relation to the total area.

The scale on the following computer generated Air Emission Figures (Fig. 1-7) is as follows:

Individual Plant Studies

Horizontal extent of chart equals 1900 meters.

Vertical extent of chart equals 2900 meters.

Regional Studies

Horizontal extent of chart equals 23,750 meters.

Vertical extent of chart equals 36,250 meters.

Source: Computer Dispersion Model, University of Oklahoma, 1975.

Fig. 1 Annual Isoconcentration Lines of Suspended Particulates in the Vicinity of Seven Potash Refineries with Control to Comply with 30-Day Standard

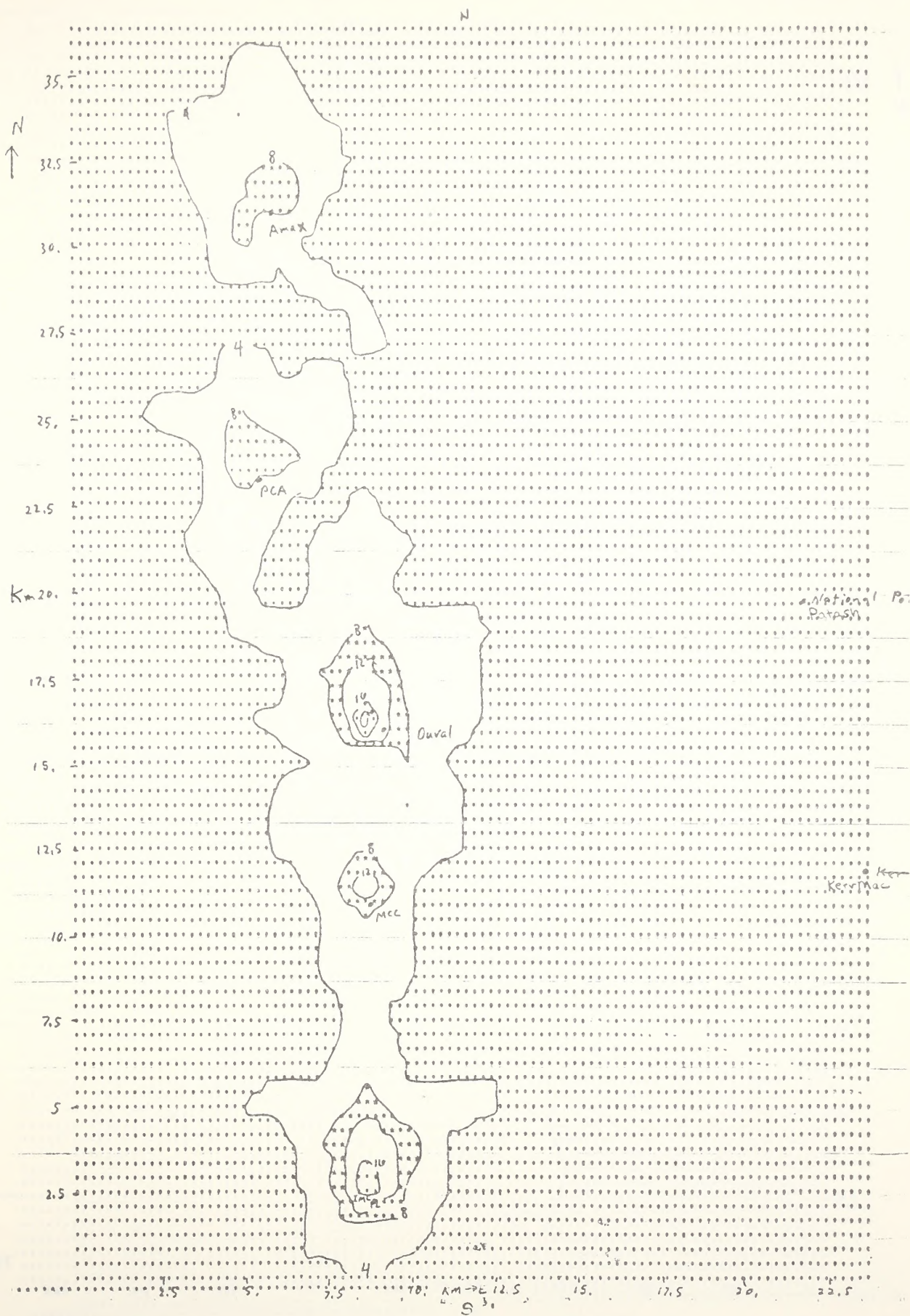


Fig. 2 Composite Analysis for all Seven Refineries Following Addition of Controls Required to Comply with Annual Standard

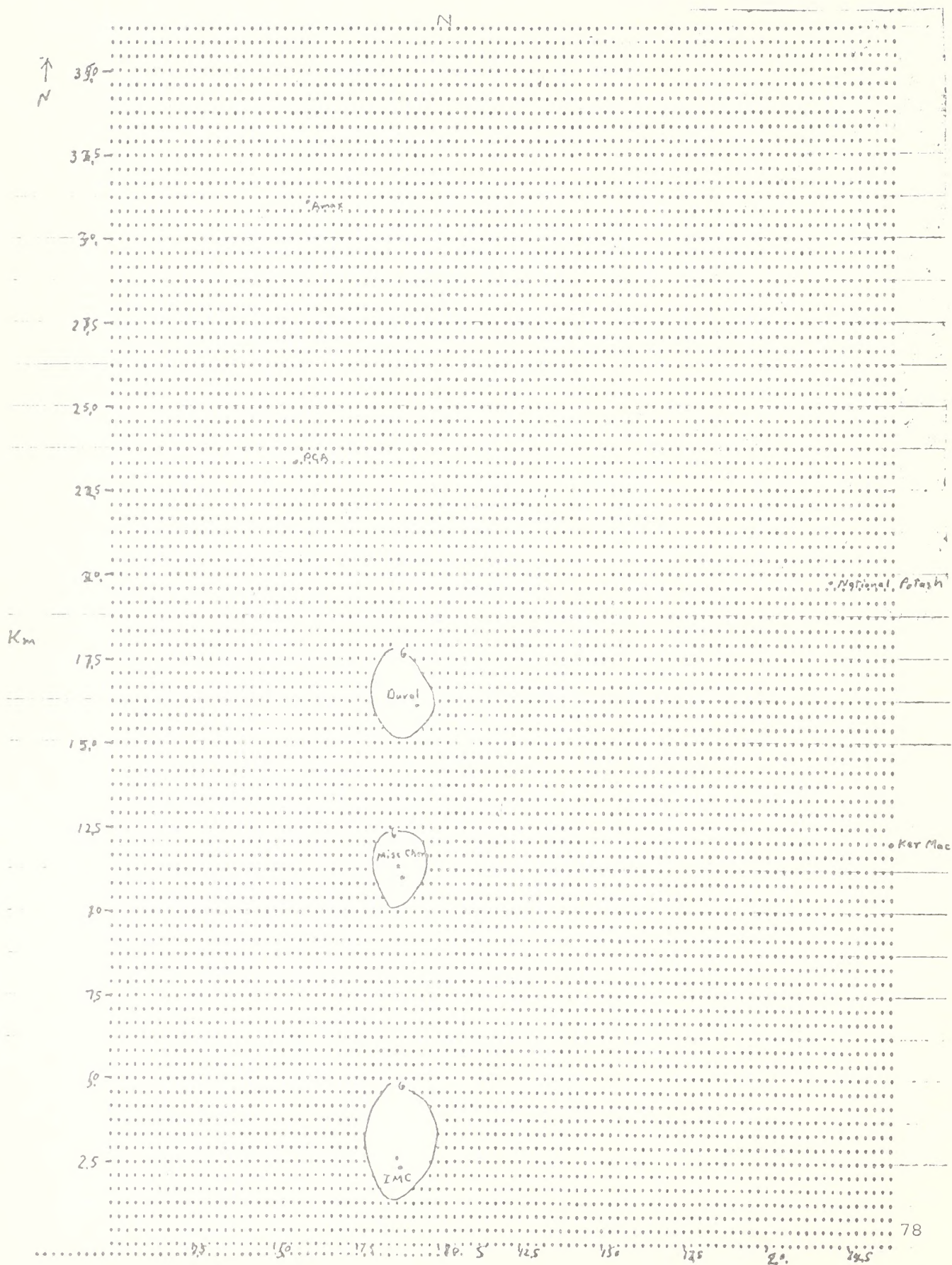


Fig. 3 Annual Isoconcentration Lines of Suspended Particulates
in Vicinity of Duval with Required Reductions for
24-Hour Standard

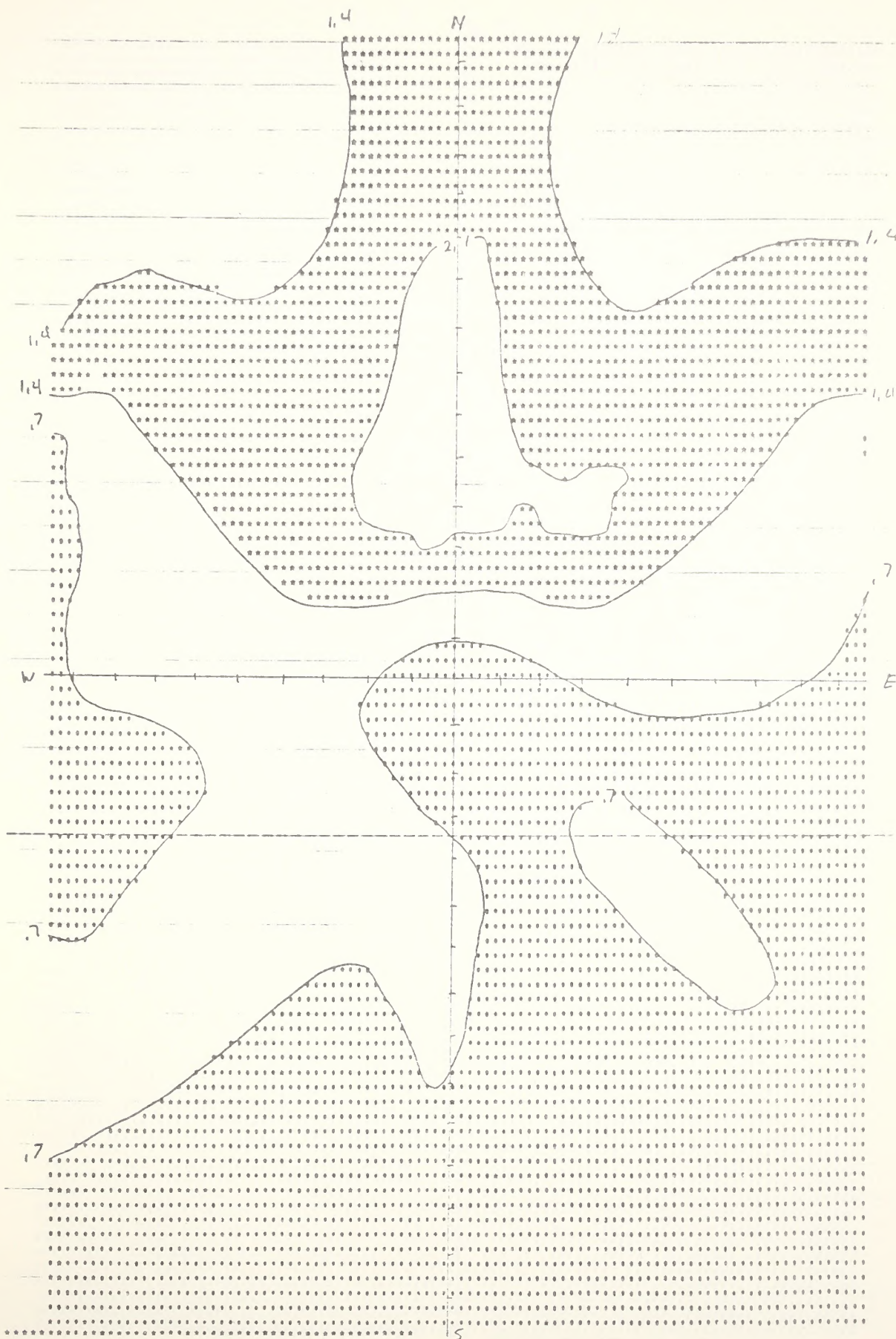


Fig. 4 Annual Isoconcentration Lines of Suspended Particulates
in Vicinity of AMAX with Required Reductions for
24-Hour Standard

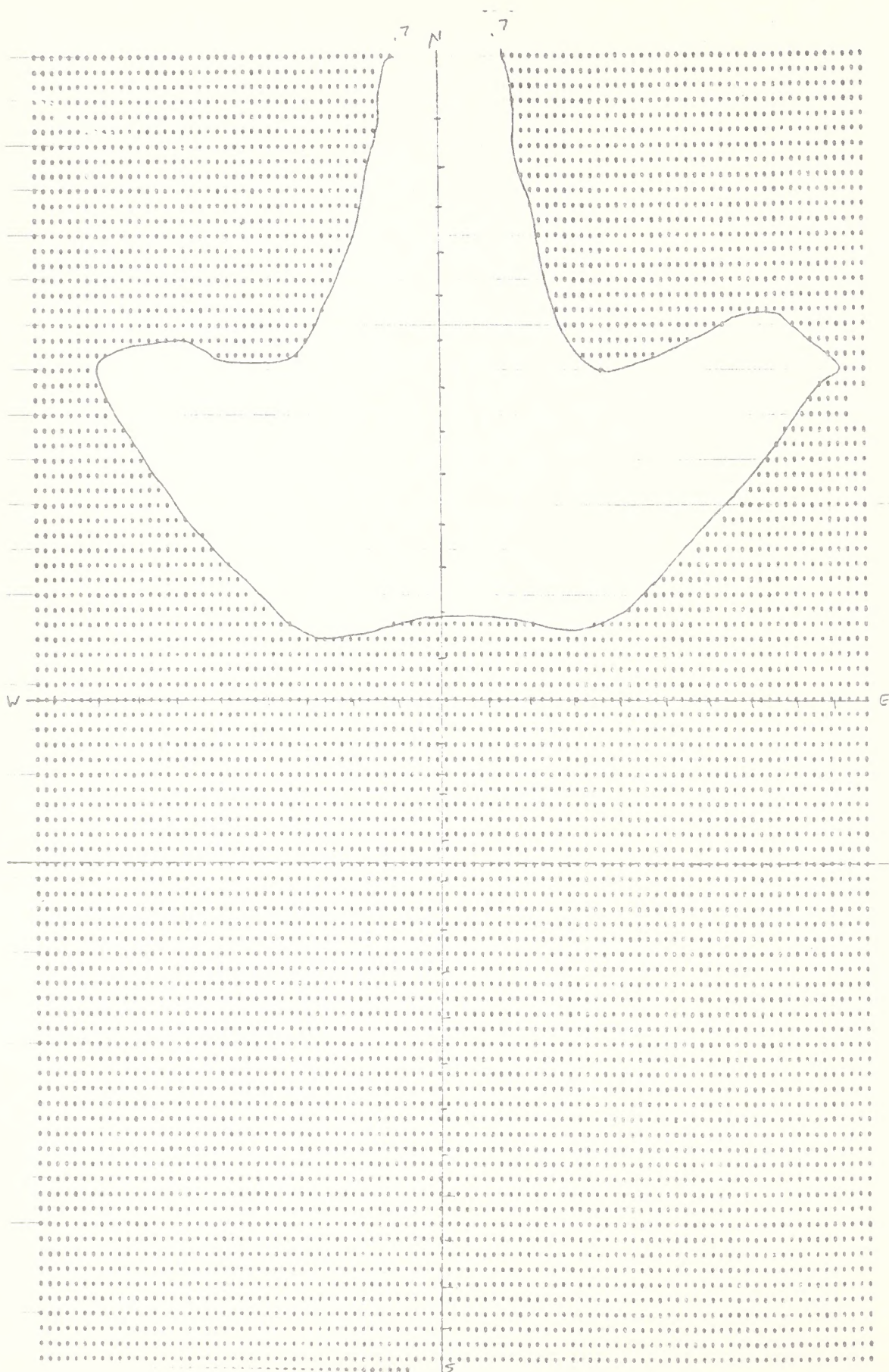


Fig. 5 Annual Isoconcentration Lines of Suspended Particulates
in Vicinity of MCC with Required Reductions for
24-Hour Standard

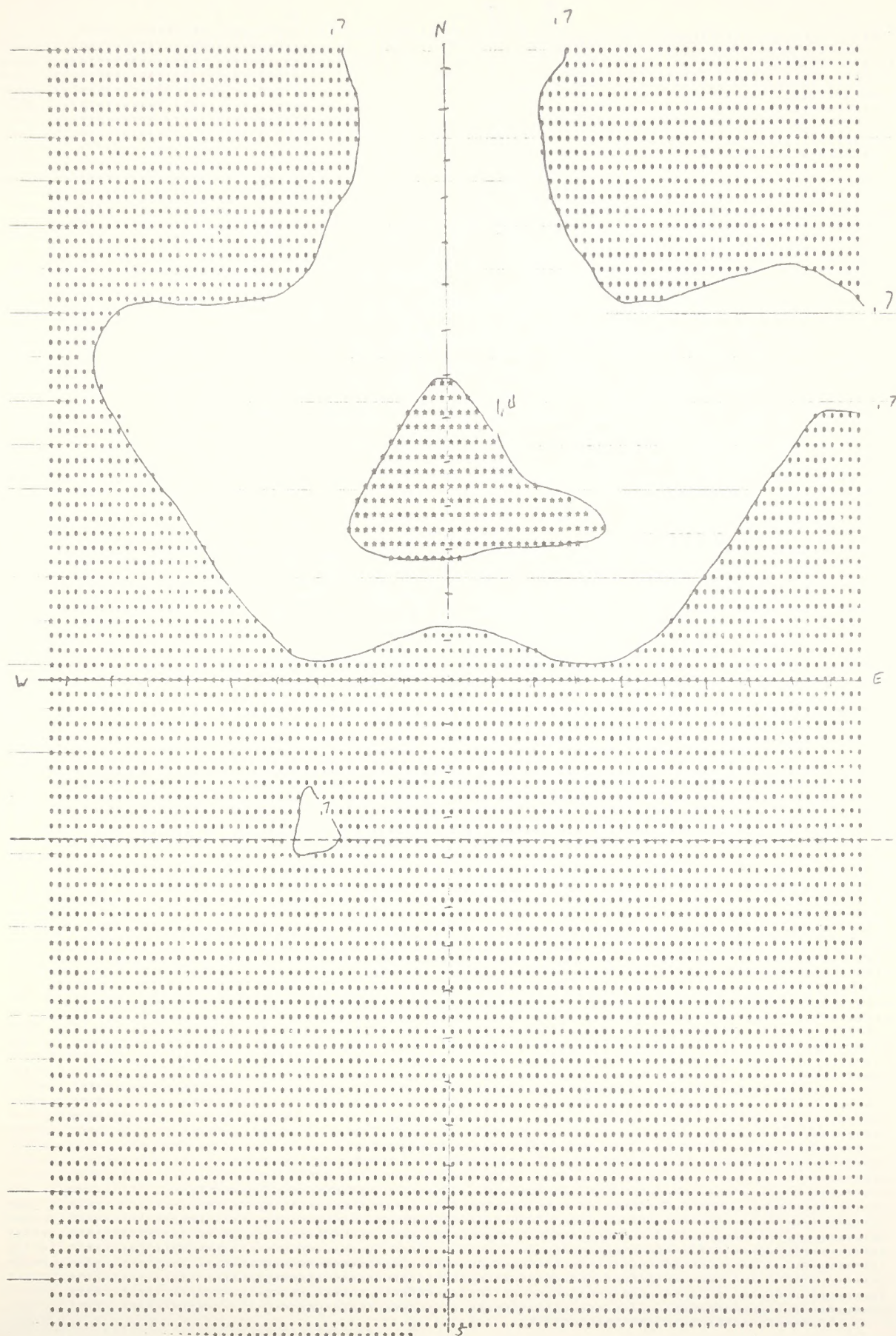


Fig. 6 Annual Isoconcentration Lines of Suspended Particulates
in Vicinity of PCA with Required Reductions for
24-Hour Standard

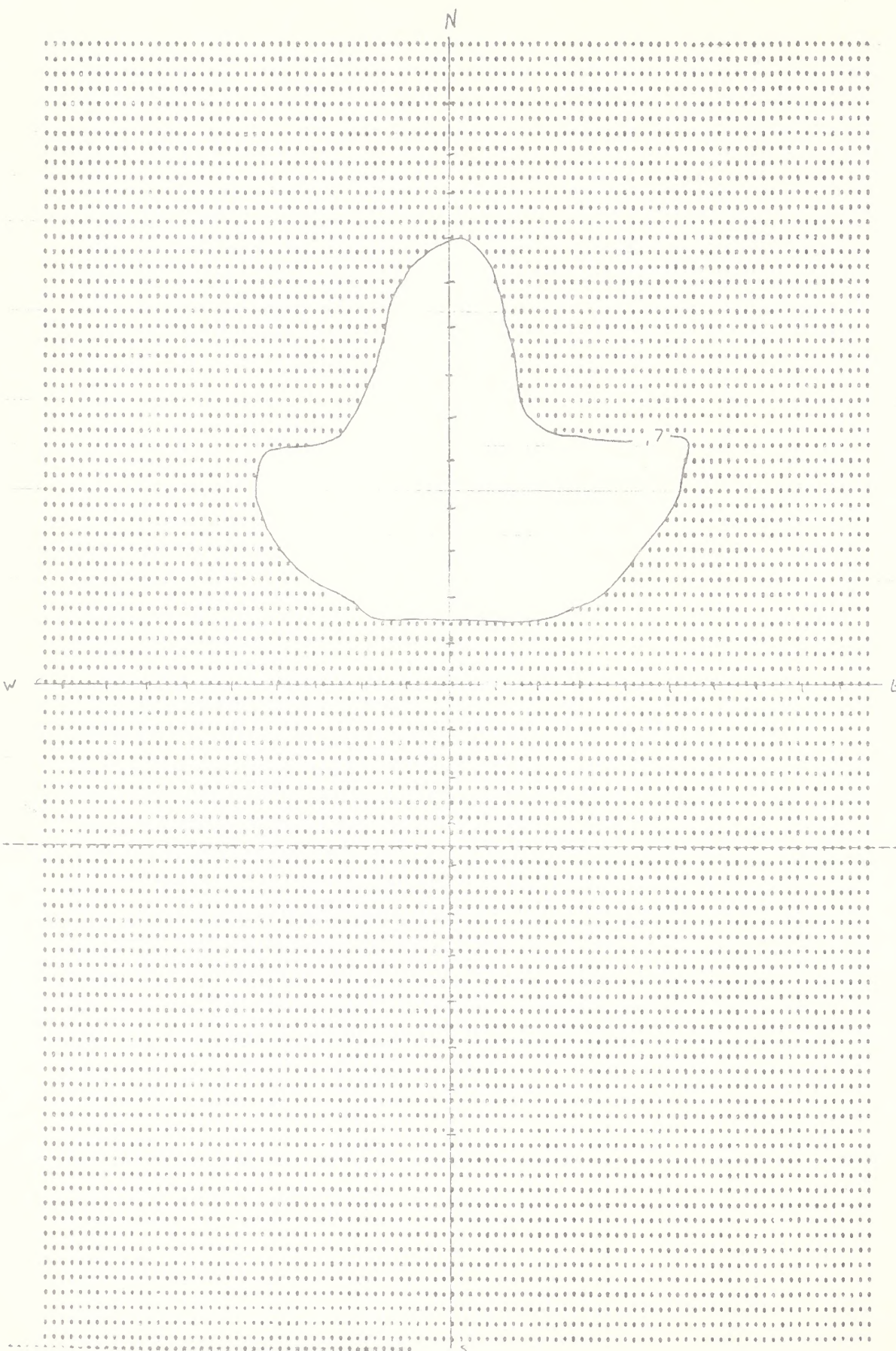
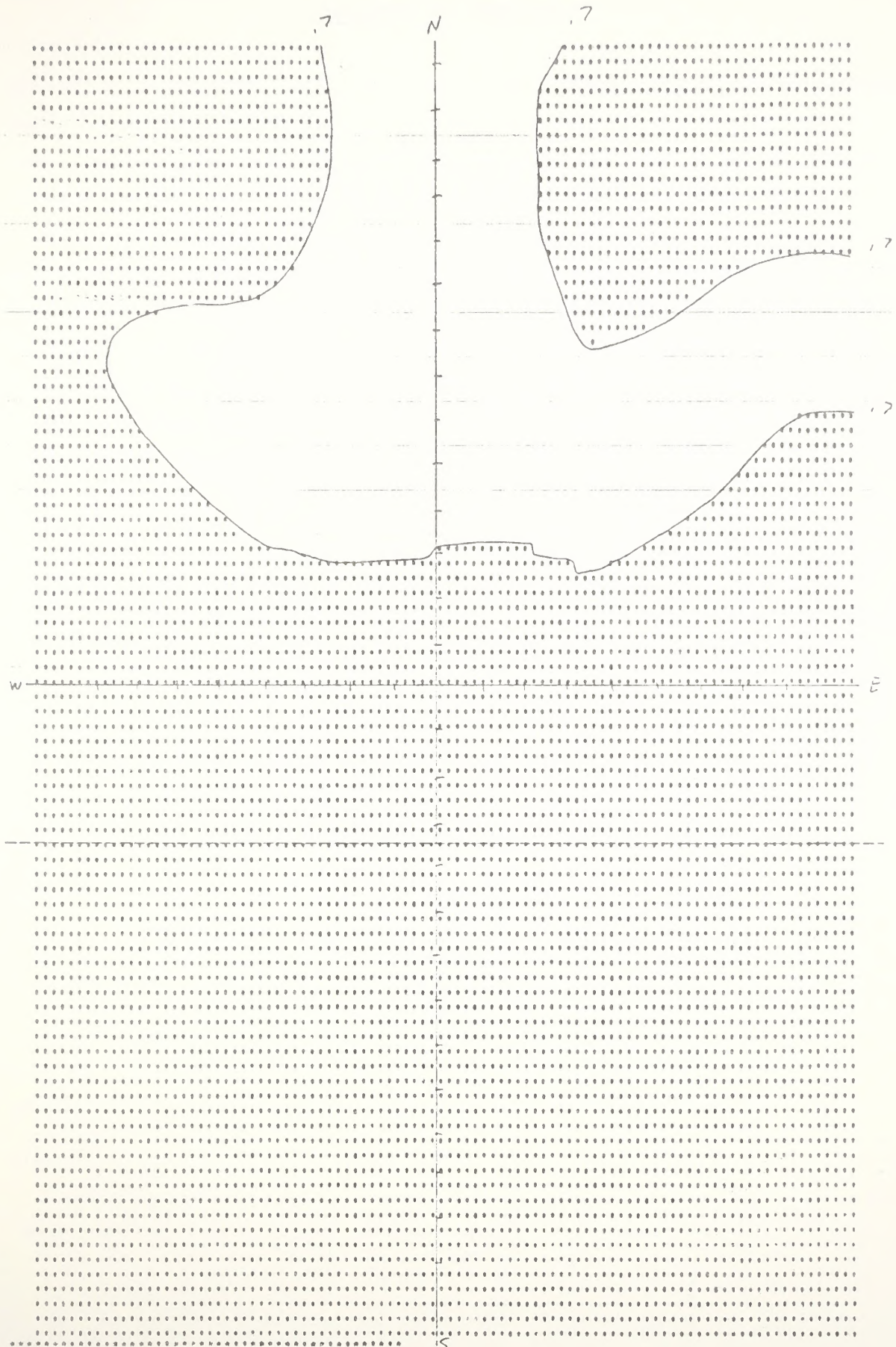


Fig. 7 Annual Isoconcentration Lines of Suspended Particulates
in Vicinity of IMC with Required Reductions for
24-Hour Standard



Response to Comments

This section responds to those substantive comments submitted by various agencies, groups, or individuals concerning portions of the Regional EAR. The comments and responses are grouped into the following general subject categories: Air Quality, Water Quality, Radioactive Waste, Alternatives, Maroon Cliffs, Oil and Gas Conflicts, Socio-Economics, and miscellaneous comments. The format for each comment includes a description of the issue, who raised the issue, and our response to the issue. In some cases a general issue was raised by more than one commentor. These issues have been stated in general terms with those who commented on this general theme listed. Responses to those comments which recommended minor text changes are included in the Minor Changes section of this supplement.

Issue:

Several written comments point out that the air quality portion of the EAR has some minor shortcomings. In addition, some commentators asked for additional information.

Issue Raised By:

New Mexico Environmental Improvement Agency, New Mexico Mining Association, AMAX Chemical Corporation, International Minerals and Chemical Corporation, United States Geological Survey

Response:

Certain specific issues and responses concerning the air quality data follows; however, it should be pointed out that the EAR was intended to describe the existing air quality situation, project future conditions under various assumptions, and explore mitigating measures relating to air quality. Based on the information available, the Bureau feels that for the most part, the EAR accomplished the intended purpose. The EAR cannot resolve all the unknowns relating to air quality. However, it has provided the impetus and the mechanism to resolve these problems.

In this regard, the BLM is working closely with the New Mexico Environmental Improvement Agency (EIA), and the Environmental Protection Agency (EPA) to see that appropriate air quality regulations are established for the potash industry. The New Mexico Environmental Improvement Board, through it's staff, is currently developing these proposed regulations. Final regulations should be promulgated by the first part of 1977.

Further, the BLM has developed stipulations (see Mitigating Measures) that the Federal Government standards will apply in the event that appropriate State regulations are not established.

The following are specific responses to comments relating to the air quality portion of the EAR:

Issue:

AMAX air quality data is incomplete.

Response:

The Bureau of Land Management recognizes that the AMAX air quality data is incomplete. It is included in the Preliminary Potash EAR in order to provide general air quality information. This was the only specific air quality data provided to BLM by any of the potash companies. Extensive additions to this data would require investigations which are not within the scope of the EAR. Complete air quality data for the seven potash refineries should be forthcoming as EIA works to establish regulations for the potash industry.

Issue:

In respect to the statement that "economical air emission control technology is lacking for Ozark evaporators" (page III-91 of EAR), the EIA requests that the control methods and costs, which are examined to reach such a conclusion be included in the EAR so that the reader might be given sufficient information so that he may come to his own conclusion as to whether they are economical.

Response:

All those contacted concerning emission controls for Ozark evaporators knew of no such controls presently available.

Issue:

The Air Quality Control Regions are inaccurate.

Response:

Priorities for Air Quality Control Regions for the State Implementation Plan were fixed during 1971 based upon air quality data obtained in 1970 or earlier. A review of the air data presented in Table II-17, page II-23, for 1970 reveals the basis for the Priority III classification for particulate matter within Region 5. It is now obvious that the classification was incorrect; however, EPA no longer utilizes the classification system. Rather, more sophisticated techniques, such as dispersion modeling, are used to determine the adequacy of a control strategy.

Issue:

On page II-42 the equivalent diameters in microns should be given along with the Tyler Mesh Numbers.

Response:

The following are the equivalent micron values:

<u>Tyler Mesh No.</u>	<u>Microns</u>
100	147
150	104
200	74
325	43
400	37
-400	-37

Issue:

Air emission modeling procedures have inherent shortcomings which may have resulted in inaccuracies in the dispersion calculations cited in the EAR.

Response:

The Bureau of Land Management is aware that there are shortcomings in air emission modeling procedures. Despite its shortcomings, however, air modeling is the best method currently available for determining air emissions and it is a standard procedure in many governmental and private organizations. The Environmental Improvement Agency has submitted detailed information regarding air emissions of the potash refineries. Excerpts from this data follow:

"A review of the procedure utilized in predicting the 24-hour maximum concentration (Appendix A-4), indicates that the EAR is open to criticism because of the technique of assuming a single stack with characteristics based upon a weighted average of the individual stack parameters. The Environmental Improvement Agency has estimated maximum 24-hour concentrations, but individual stack parameters were utilized. A low and a high concentration were predicted, depending on the ratio used for converting the short-term concentrations to maximum 24-hour concentration. These predictions are presented in Attachment I.

(EIA ATTACHMENT I)

Potash Impact Estimates

Preliminary estimates of the concentrations resulting from operation of seven individual potash plants in Southeastern New Mexico were made. The emissions used were those estimated by the Bureau of Land Management and a 24-hour time averaging period was chosen. BLM made estimates of the annual concentrations in the environmental assessment for these plants and so

was not dealt with here. The meteorology used for the 24-hour estimates with D stability and wind speeds of 3 to 5 m/sec. (6.7 to 11.2 mph). The ratio for 24-hour concentrations to short term concentrations should be in the range of 0.20 to 0.30 or higher. This range of values is based upon measured data collected by the Air Quality Division; and data collected by private companies and also upon the observations of continuously recorded wind speed and direction data. The Hobbs "Star" data collected by the National Weather Service indicates a strong occurrence of neutral conditions, particularly from the SW during the early spring months were the monthly frequencies are from 13% to 15% of all observations in any direction and for all stability classes. This simply means that there are some 24-hour periods which have a very significant direction duration.

Each stack was modelled individually as a point source using the PTMTP model developed by D. B. Turner of EPA. Since plot plans were not available to show the physical stack layouts, a single stack origin was used. In other words, if a plant had 5 stacks, each stack was assumed to be located at the same physical location within the plant, however each of the 5 stacks was modelled individually using its own characteristics of height, source strength, effluent temperature, volume flowrates, etc. as opposed to the method used by BLM of performing some sort of parameter averaging to obtain a single "average" stack.

The results of the estimates is shown in the following table as 24-hour average concentrations. No attempt has been made to adjust concentrations for the particulate size distribution which would affect fallout very near the plants. The table presents the highest calculated estimates.

<u>COMPANY</u>							
24 hr. Conc. ug/m ³	Duval	National	PCA	Miss.	Kerr	IMC	AMAX
low	385	26	648	117	156	682	432
high	577	40	973	175	234	1023	648

Southeastern New Mexico Potash Plant Concentrations.

Conclusions:

It would appear that 5 of the 7 potash plants are capable of exceeding the New Mexico Air Quality Standards for particulates. The tabular results do not include any background particulates levels. If a background concentration level of 40 ug/m^3 is used then only one plant appears to have concentrations lower than standards. In most cases, particulate levels drop to standards within 5 km from the plant. However, it is quite possible that stable atmospheric conditions could produce higher levels at greater distance from the plant.

Particulate fallout would lower these estimates however, it is not known by how much.

All of the plumes, except perhaps National Potash would appear to be highly visible sources of particulate emissions at these levels of emissions. It is difficult to estimate the visibility impact of the sources since each plume at a plant is at a different elevation."

There has also been concern about a discussion of the differences between road dust and industry particulates. As stated on page II-33 of the EAR: It should be noted that emission inventory information is useful for general air quality management and trend analysis. It does not include consideration of atmospheric reactions and the damage associated with a given weight of pollutant.

Issue:

AMAX Corporation submitted soil analysis information which they feel contradicts some of the BLM conclusions relating to the impact of particulate fallout on soils.

Response:

The BLM approach in soil sample collection was to check certain areas to determine if environmental impacts were present, while not

becoming engaged in detailed sample collection which would have required a great deal of additional time. Similar methodology of soil sampling was used by both BLM and AMAX, except BLM did not mix the surface samples. In BLM's sampling process, they analyzed the surface crust. This sampling was correlated with soil series, soil depth, restrictive horizons, backing capabilities, etc., because of the soil-vegetative relationship in the EAR. Samples were collected around all potash refinery sites, in all directions, to distance, except in directions of brine ponds and tailings piles. All of these analyses were correlated with soil data from Lea and Eddy County soil surveys. The presence of a semi-permeable layer (caliche) incorporates a situation for salt accumulation. If soils have restrictive layers, the effective root zone of vegetation will be affected. Both BLM and AMAX analyses acknowledge decreased values of salts from the source out to distance. With proper reading, it is found that soils tests, in and of themselves are not treated as an independent variable, but are correlated with climatic conditions, seasons, plant competition, etc.

Issue:

The governmental agencies ran only one transect consisting of only four soil samples.

Response:

One transect, comparing surface soil analysis with distance for the refinery site was submitted in the text. However, it should be considered that in Appendix 10, (Soil Analysis) that four transects plus a "control" with a total of 36 samples were collected around

the AMAX site for consideration. Further, a total of 154 samples were collected around the potash area at all sites.

Issue:

The BLM states that, "The sides of the javelina bush facing the refinery are mostly defoliated, while the opposite side may not be." This statement is not logical.

Response:

The BLM statement is valid since in the EAR it stated, varied detrimental effects from refinery air emissions in the vegetation," which is a statement considering all effects from industry and not just dust particulate.

General Issue:

There are several errors and data gaps in the EAR relating to water quality.

Issues Raised By:

New Mexico Environmental Improvement Agency, New Mexico Citizens
for Clean Air and Water

Response:

Responses to specific comments regarding inaccuracies follow. With regard to data gaps, the BLM acknowledges that numerous unanswered questions relating to ground water hydrology still exist. However, the information required to answer these questions is currently unavailable and beyond the scope of the EAR to develop.

The BLM and USGS, in cooperation with other State and Federal agencies, are taking steps to develop the needed information. USGS ground water studies are continuing in the area.

The BLM is working with the New Mexico Environmental Improvement Agency to develop a contract to analyze the ground water situation in relation to the potash industry. In addition, the BLM will include stipulations in potash leases allowing additional mitigating measures for water quality should these studies prove them necessary (see Mitigating Measures section).

Issue:

Section I.D.1.c., page I-59, requires several corrections.

Response:

This section is corrected in the Minor Text Changes section of this supplement.

Issue:

On page II-173, subsection II.A.3.b., it is stated that a discussion of brine chemistry is to be found in Appendix A-7. However, in A-7, there is only a chart of chemical analyses of samples from various sources.

Response:

The proper references are Appendices A-17 and A-18.

Issue:

In sections II.A.3.c., d., and e., starting on page II-173, reference is made to various lagunas, brine ponds, etc., with tables giving surface areas (II-61) and chemical analyses (II-65). A map should be included showing locations of these bodies of water.

Response:

A non-detailed, general information map is included at the end of this supplement. The general locations of the potash refineries and bodies of water are plotted on this map.

Issue:

Page II-179 discusses ground water recharge and movement, but no information is given about the general direction of movement. Several of the references given on this page are quite clear and specific about this subject and their information should be included.

Brokaw and others (1972, page 56) state, "Ground water in the formations above the Salado Formation moves generally southward and southwestward across the potash mining area towards the Pecos River. Most of the discharge of the ground water takes place in the reach of the Pecos River near Malaga Bend." Robinson and Lang (1938, page 100) conclude, "A body of concentrated solution of sodium chloride occurs at the base of the Rustler formation and overlies the extensive deposit of salt known as the Salado halite... The brine in this horizon is under artesian pressure and has, in general, a southward hydraulic gradient."

Response:

The statement by Brokaw and others (1972) is only partly true. Ground water does move generally south, but much brine discharges into Laguna Grande. Some brine discharges into the Pecos River. A statement is made p. III-197 about brine movement. Without more data this statement cannot be amplified.

Issue:

On page II-179, it is stated that sinkholes appear to leak badly and that the water from them is discharged not into rocks of Triassic age, but rather into rocks of Permian age. The uppermost rocks of Permian age should be identified by name as the Rustler Formation (see Figure II-36), since this formation figures prominently by name elsewhere in the EAR.

Response:

This is a reference in which rocks were not differentiated to formations. It is better not to stretch the interpretation.

Issue:

Section II.A.3.d., (pages II 180-185) concerning Laguna Grande de la Sal and Anderson Lake, indicates that there has been an increase in recent years in salt load pickup between the USGS gaging stations at Malaga Bend and Pierce Canyon, and that the increase is believed to be principally due to leakage from Anderson Lake. It would help readers to see what the change has been if columns 2 and 3 of Table II-63 on page II-184 included data for several years immediately preceding the start of pumping at Anderson Lake, as well as some older data from previous decades.

Response:

An illustration will be placed in future USGS report showing this relation. (Evaporation and Leakage of brine from Anderson Lake at Malaga Bend, Eddy County, New Mexico, Kunkler, J. L., 1976, in review). This illustration is subject to review and possibly to revision. These data are not sufficient to show precise effects of the pumping of well USGS 8, but they suggest that this pumping has reduced the inflow of natural brine at Malaga Bend by at least 50 percent and possibly much more. If Anderson Lake were brine-tight, the quality of Pecos River water below Malaga Bend would now be much better than prior to 1963. The data does show that the increase in salinity of the river water is due to leakage of brine from Anderson Lake and that there is a very low probability that any refinery effluent is moving into the Pecos River. These data do not prove that the brine lakes in the Clayton Basin and Nash Draw have had no effect upon the inflow of natural brine at Malaga Bend; however, they do indicate that this effect is small if any. In summary these data indicate that fears of catastrophic pollution

of the Pecos River by refinery effluent are entirely unwarranted; moreover, in view of the probability of near stabilized hydrologic conditions in lower Nash Draw, fears of imminent pollution probably are unwarranted also.

The methods of interpretating these data are very complex and require more information than is appropriate for this EAR.

Issue:

On page II-198, it is theorized that the brine lakes in lower Nash Draw will "grow if greater amounts of effluent flow into the area, until they overflow into Laguna Grande de la Sal." Laguna Grande de la Sal is believed to leak very little now, but something should be said here about the possibility of future leaking if it grows and is filled beyond that area which is relatively impervious.

Response:

The possibility that Laguna Grande de la Sal might leak if brine levels are raised significantly above natural levels is recognized and discussed on page III-61 of the EAR. Due to the huge evaporation potential of Laguna Grande de la Sal it is probable that this lake could receive large additional brine inflows without significantly raising the brine level. the United Salt Company apparently believes that it would be desireable to maintain higher brine stages to facilitate recovery of salt by their barge operations. A greater yield of salt from this lake will greatly mitigate the environmental hazards due to raising the brine levels in Laguna Grande.

Issue:

On page II-198, the third paragraph treats chemical analyses of brines from USGS #8 and notes that the lack of increase in potassium concentrations in this well indicates that effluent from the refineries has not yet polluted the Pecos River. It should be noted in the EAR that potassium concentrations in the Pecos River itself have risen considerably over the years. USGS Water Supply Paper No. 970 (1943, pages 170-171) gives average potassium concentrations of 13, 13 and 7.5 parts per million at Pierce Canyon for 1939, 1940, and 1941 respectively. USGS STORET data gives 27 mg/l at Malaga and 108 mg/l at Pierce Canyon as the average of approximately 200 measurements taken from 1960 to 1975. If the increase has nothing to do with the potash industry, this should be explained.

Response :

It is agreed that this evidence needs explanation which is that the comparison of weighted averages against arithmetic averages at these sites is mathematically invalid. If the weighted average of potassium (15 mg/l) for the 1969 water year at the Malaga gaging station is compared against the weighted averages at this site for the earlier period the evidence for widespread pollution by the potash industry vanishes. Even a comparison of weighted averages is not mathematically valid because these values are largely dependent upon the amount of storm runoff passing the station. For similar and additional reasons a comparison of arithmetic averages is also invalid. There is no doubt that the weighted average salinity at the Pierce Canyon gaging station is greater than prior to 1963 because of numerous complications caused by the leakage from Anderson Lake. There is also evidence of new brine leakage

above the Malaga gaging station. This evidence is from chemical analyses of river samples collected during a seepage run and was evaluated previously without definite conclusion, but it is suspected that the increase in salinity is due to hydrologic changes caused by leakage from Anderson Lake. It is infinitely more probable that this inflow is leakage from Anderson Lake than from some effluent pond. In any event, the new brine inflow is very small.

Issue:

Page 11-180-5 indicates in recent years the salt load has increased between the USGS gaging stations at Malaga Bend and Pierce Canyon. It is believed this increase is due to leakage from Anderson Lake. It would help put this in perspective if Table 11-63 included data from past decades and for the several years prior to the start of pumping at Anderson Lake.

Response:

An open-file report (Kunkler and Havens, 1976, in review) entitled Evaporation and Leakage of Brine From Anderson Lake at Malaga Bend, Eddy County, New Mexico gives overwhelming evidence that the recent increase in salinity of the Pecos River in the Malaga Bend reach is due to leakage from Anderson Lake. Some of the data from this report are given also in Table II-63. It is extremely significant that the leakage from Anderson Lake is greater than the annual increase in salinity of the Pecos River at Malaga Bend.

Data on brine inflow into the Pecos River in the Malaga Bend reach are given also by Hale and Others (1954, pl. 4).

Issue:

On page II-198 several arguments are made to imply the potash industry has not yet polluted the Pecos River. One such argument is the lack or increase in potassium levels observed in brines from Well USGS #8 over the unspecified years of its study. The real question, of course, is what has happened to potassium levels in the Pecos River itself over the years the industry has been operating? These data surely are available and should be included and compared in the analysis record.

Response:

In view of a reinterpretation of the hydrology of Lower Nash Draw, it is presently believed that pollution of the Pecos River by refinery effluent is less likely than supposed by the EAR. For many reasons the potassium concentrations of river water will not necessarily reflect true pollution by the potash industry. Important reasons are:

- (1) Although Anderson Lake leaks badly, it also evaporates much brine. Because of this evaporation, potassium concentrations in the brine leakage are now greater than in natural inflowing brine prior to 1963.
- (2) Leakage from Anderson Lake is greater than the natural inflow of brine prior to 1963.
- (3) Most leakage from Anderson Lake is nearer the Pierce Canyon gaging station than was the natural brine spring area prior to 1963. This condition allows a much greater average daily concentration of potassium in river water. These three conditions combined

cause even greater average daily concentrations of potassium in river water. In addition there are other unreviewed conditions that may aggravate this problem. Also, there is evidence of new brine leakage above the Malaga gaging station (see response to similar comment above).

Issue:

The "Alternatives" analyzed in the report are unacceptable, unreasonable, and if implemented would cause serious and irreparable disruption of the potash industry, and associated socio-economically related concerns.

Issue Raised By:

This general theme and tone relating to the alternatives was expressed by numerous individuals and organizations. Many responded with specific objections to each of the alternatives. See the summary of public comments which is a part of this report. Excerpts from written comments relating to "Alternatives" have been included in this section.

Response:

The alternatives analyzed by the team were those thought to be reasonably available, technically feasible, and could make a difference environmentally. The BLM felt that these alternatives should be evaluated to give the decision maker and others an understanding of the environmental differences between alternatives.

The information provided by commentators does not really change BLM's responsibility to analyze these alternatives. Most of this information relates to reasons and rationale as to why the alternatives are not valid. Some of the data is related strictly to economic considerations.

Since the BLM does not propose any of these alternatives and since all comments relate to the invalidity of them, no substantial changes have been made in the section.

Submitted by Joseph E. Gant, New Mexico State Senator:

"Over 5000 employees in the potash industry by the year 2000 is indeed an intriguing projection in the social-economic section of EAR Draft. What about the present 2800 employed today by the potash industry? I see the alternatives as written to be a slowdown for the near term. Without exploration there will be a fall off of employment and production.

All of us would appreciate, as given under the alternative, Delayed Action (pending legislative changes) this part calls for plant research. But, why wait ten (10) years for this research to get started?"

Submitted by Hollan Cornett, Staff Representative, United Steelworkers of America, AFL-CIO:

"The suggested alternatives to the Bureau's proposed action are completely unagreeable to the United Steelworkers Union and our membership. None of the suggested alternatives takes into account the human suffering and disruption of the lives of the workers and their families that will result from the unemployment caused by the adoption of either of the alternatives.

If Alternative (a) is adopted, it will bring about a series of lay-offs of workers in very short order. All too soon, the Potash Workers would all join the ranks of the unemployed. The Worlds supply of Potash for fertilizer would all come from Canada, East Germany and other Foreign Countries. The American Farmer would soon again be at the mercey of the cartel which controls the Potash in Eastern Europe and the Government of Saskatchewan and Canada.

A delay of issuing new leases, prospecting permits and the readjustment of existing leases for some two to three years as suggested in Alternative (b) will shorten the life of some of the existing operations and will bring about lay-offs of workers.

It will also be a waste of a valuable natural resource. I might say a very vital natural resource and something the American Farmer can not do without.

Some of the other suggested or possible alternatives in the report would mean immediate disaster for the Potash Workers in Southeastern New Mexico, as well as, the City of Carlsbad and the State of New Mexico. We sincerely hope that none of the suggested alternatives are ever entertained by the Bureau of Land Management or any other Governmental Agency.

Any delay in allowing the present operators to proceed with their planned exploration and expansion of their mines and refineries will have an adverse effect on the economy of Southeastern New Mexico and the State as a whole.

Lay-offs of Workers in the Potash Industry are nothing new to us. Market conditions and other factors have caused us to suffer lay-offs in the past. We have suffered through several years of depressed market conditions. We have seen the New Mexico Potash Industry's Market taken over by foreign producers in the past. the World Market for Potash is growing every year. The present producers in Southeastern New Mexico have worked very hard to garner their fair share of this market. Through their efforts we now have a fairly stable employment situation and local economy."

Submitted by S. E. Reynolds, New Mexico State Engineer:

"At page I-95 the report suggests that BLM could bring about the use of alternative water sources by restrictive lease stipulation and prohibiting the authorization of new water pipeline rights-of-ways. There appears to be some possibility that such lease restrictions or denials of rights-of-way could prevent development that would otherwise be practicable, and could even have a serious impact on investments already made. Some discussion in the record of these ramifications of restrictive lease and rights-of-way provisions might be useful."

Submitted by Mike McCullough:

"I propose that you adopt a modified Delayed Action Alternative. The modification being, that you lift the moratorium on issuance of new leases and readjustment of existing leases so that the potash companies will be able to expand and insure both a healthy local economy and a national economy."

Submitted by AMAX Chemical Corporation:

"The potash industry's position is that the alternatives as stated in the EAR are too stringent and not supported by the data presented in the EAR. We know that the industry is not damaging the environment to an extent to justify such alternatives.

The first alternative, called "No Action," would allow the present operations to continue but bans any expansion of the industry. A ban on the issuance of new potassium leases and prospecting permits, and no readjustments on existing leases is not consistent with the stated policy of the BLM to encourage the development of the mineral resources under its jurisdiction.

It is imperative that the low-grade ore reserves within the potash basin be developed when it is economically feasible to do so. There is probably a large amount of low-grade potash deposits on land within the study area that can presently be developed. Much of this ore would have to be blended with some of the higher grade ore, which is presently being mined, in order to economically justify its production. Most of the deposits are low grade and are small which would require that they be mined from present mines and processed in present refineries. They would not justify the building of new mines and refineries. These deposits will be lost if allowed to remain. Some of the deposits, no doubt, would justify building of new mines and refineries and these also should be utilized.

The second alternative requires that a moratorium be place on all new actions for a period of two to three years to allow the Department of the Interior to gather additional data. A delay of this period of time would assure that much of the low-grade ore would be lost. If the industry is to progress in an economical and efficient manner, it must be allowed to develop mining plans over a several year period. The industry cannot sit by for years before it knows if any additional ore will be available, the ore grade, amount, thickness of bed, extent of the ore body, and location and characteristics of the ore.

The State Environmental Improvement Agency is charged with the responsibility for setting environmental standards for industries

within the State. This agency is presently working to develop air emission regulations for the potash industry. This study can proceed simultaneously with potash exploration and development. After over forty years of potash orderly development, the industry does not think it unreasonable that these studies be carried on during exploration and development.

The third alternative concerns problems of another company that could best be answered by them.

The fourth alternative of requiring the leaching and crystallization refining process be implemented through restrictive lease stipulation on future potash leases would, in effect, require any new development would have to be processed through new refineries. The environmental impact of the existing refineries does not justify that flotation refining be discontinued. This alternative would assume that much of the potash ore present on non-leased land would be lost because the ore bodies would not justify the cost of new production refineries.

Submitted by Southeastern New Mexico Economic Development District:

"ALTERNATIVES WITHIN EXISTING AUTHORITY"

A. No Action:

The "no action" alternative involves instituting no changes in present potash activities or procedures in the Carlsbad Potash Basin. Under this alternative, the potash industry will be permitted to continue actions as they now exist with no new leasing or lease re-adjustments.

The potash industry is a supply and demand industry providing jobs and services to citizens of the production area as potassium fertilizer products increase or decrease in sales. The current concern over a "food shortage" has prompted increases in demand for all fertilizer products. The Carlsbad area produces 90% of the nation's total potash production.

Industry expansion will necessarily occur through the enactment of new leases and lease re-adjustments. The alternative of "no action" will limit the life of the potash industry in the Carlsbad area. Estimates vary as to the productive life

of mining under present leases, but most experts agree that as soon as future production is limited, actions by the United States to import potash from Canada will strongly resemble efforts to import oil from the Middle East. Job losses and secondary business shut-downs will occur gradually as soon as the "no action" policy is clear to industry leaders. Industry leaders will take this action to prolong the production of existing leases. Prices of potash and fertilizer products will rapidly increase, causing "false shortages". It will then be necessary for the U. S. Government to once again intervene to control the inflationary effect of the supply-demand imbalance.

Additionally, industry spokesmen indicate that a twenty year supply of ore will be needed to support the necessary capital investment from mining and processing. "No action" could also cause an immediate phase-down of existing mines. The job, secondary business and cash flow losses will be devastating to the economy of the area. Economic disaster efforts by the federal government may then be necessary.

B. Delayed Action (postpone action pending further study):

AMAX Chemical Corporation filed applications for prospecting leases in April of 1974. The present moratorium on new leases or lease re-adjustments has delayed action on these lease applications almost two years. An additional delay of 2 to 3 years plus the necessary 2 to 3 years from application approval to mine production, will create serious hardship on the industry.

The rapid depletion of high-grade ore in the Carlsbad Potash Basin has caused several companies to look at the economics of mining lower-grade ore to increase the life of their properties. Blending of high-grade and marginal ores is the only economically feasible way to take advantage of this possible extension of the life of the industry in the Carlsbad Potash Basin. The main ore stream of high-grade ore extends beyond existing potash lease boundaries.

Further delays or moratoriums of up to 2 to 3 years may cause a serious slowdown of the industry, thereby, causing price hikes for potassium fertilizers, caused by short supply. With current construction costs and cost increases, this blending process may become economically unfeasible before action is taken on new leases.

C. Alternate Site for Proposed Mississippi Chemical Corporation (MCC) Mine Shaft and Refinery:

The selection of alternate sites for the MCC shaft and refinery to protect the environment necessitates the use of a previously contaminated refinery site. This alternative will cause additional economic hardship to the Mississippi Chemical Corporation. Mississippi Chemical Corporation seeks to move its refinery site due to the cost of transporting of ore from the tenth ore zone. The new refinery will be structurally, economically and environmentally superior to the present MCC refinery.

Though the shifting of refinery sites will cause some environmental effects due to construction of a rail spur, water lines and ingress-egress roads, the major environmental effects will be confined to the proposed 72 acre refinery site. If MCC is forced to maintain its present site, higher operations costs due to transportation costs of ore may soon make the MCC mine into a marginal operation.

It is debatable as to whether the environmental impact is more serious at a new refinery and site or at the present refinery and site. The economics of the industry strongly suggest the establishment of the new refinery and site.

D. Leaching and Crystallization Refining Process:

This alternative would require the use of the leaching and crystallization refinery process rather than the more commonly used selective flotation refinery process. The cost-benefit ratios of this process can best be determined by the Kerr-McGee Chemical Corporation; the only company in the Carlsbad Potash Basin with a leaching and crystallization refinery.

It is recommended that a full analysis of this process be made by industry officials and B.L.M. before this alternative is seriously considered. The difference between initial cost and operating efficiency of the leaching and crystallization process should be compared with the selective flotation process on both high-grade and marginal ore. This should determine the net benefit of this alternative and answer the question of whether the alternative might be an inhibitor to future potash production in the Carlsbad Basin.

ALTERNATIVES OUTSIDE EXISTING AUTHORITY

A. Delayed Action (pending legislative change):

This alternative would create a delay of approximately 10 years while the Department of the Interior seeks certain legislative changes. The pilot plant research (EAR Page I-93) should be designed to discover if it is feasible to:

1. Mine potash using less electricity
2. Improve underground ore recovery
3. Refine potash using less water, natural gas and electricity
4. Economically refine lower grades of potash ore
5. Improve the refinery recovery from potash ore
6. Improve tailings and brine disposal techniques
7. Improve an emission control technique

This alternative is not practical to the consumers and producers of potash and potassium fertilizers. The 10 year delay would be sufficient to slow down and possibly shut down the potash industry in the United States, leaving the nation to the mercy of foreign producers of potash.

Economists and industry officials agree that now is the only time to develop and blend the marginal and high grade ore of the basin. Without new leases and lease re-adjustments, this practice will not be developed. The supply of high quality ore is short, unless the blending procedure is practiced, it will be gone.

It is recommended, however, that pilot plant research by the Department of the Interior be initiated to accomplish the objectives as mentioned on Page I-93 of the Environmental Analysis Record. In this case, a positive impact to both the economics and environmental concerns of the area will be felt. This is the only governmental intervention in the potash industry that is economically feasible at this time.

B. Stop All Current and Prohibit All future Potash Operations:

As stated in the E.A.R.: "This alternative would involve the government purchase of all existing potash lease rights,

mines and refineries. All operations would be shut down. Also, no new prospecting permits or leases would be granted.

"This alternative would stop all environmental degradation associated with potash operations.

"The elimination of the potash industry is not a viable alternative. It will not be considered further because it would not accomplish the purpose of the proposed action, which is to make potassium available for fertilizer."

We do not feel that it is necessary to make further comment on this alternative.

C. Immediate Re-adjustment of All Existing Potash Leases:

This alternative would involve the immediate re-adjustment of all existing leases, whether or not they have been in effect for the 20 year adjustment increment. The re-adjustment would up-date surface protection stipulations, royalty rates, bonding requirements and other lease items.

This alternative would bring immediate pressure on potash industries through raising of royalty rates, bonding requirements and improved surface protection stipulations. Though this alternative has no economic impact other than psychological effects, the environmental improvements will also be small. The tone of the Environmental Analysis Record is that the potash industry in the Carlsbad Basin is a relatively "clean" industry. Environmental scars are inflicted only at the seven plant locations in the way of mine shafts, tailings and brine pits. The average refinery site covers approximately 80 acres of which only about 15% to 20% is being used for mine shafts, tailings ponds or brine pits.

D. Export and Import Adjustments:

"This alternative would constitute a reduced potash export level and increase import levels to the extent that more potash becomes available for use in the United States. If exportation is decreased while importation is increased to the extent that domestic demand for Carlsbad potash is reduced, the life of the Carlsbad potash ore reserve will be extended."

While the purpose of this alternative is to extend the life of the Carlsbad potash ore reserve, its effect could be economically devastating. The potash industry is now ruled by supply and demand. Within the past three years, potash has ranged in price from approximately \$150 to over \$400 per ton. Import-export quotas have been provided on many industries. Probably the best known import quota is the "milk quota" as established through U.S.D.A. This quota system allows for support levels for milk and milk-product producers. The effort is to control and stabilize prices of milk. The end effect has been typical of government interference in the supply-demand cycle.

The potash industry has provided jobs and services through a supply-demand economy. Any interference, federal or otherwise, may cause industry depression. Depression of the potash industry means a cutback in its present \$35 million payroll and loss of some of its 2,800 jobs. Additionally, support industry and its employees will suffer.

E. National Potash Policy:

A national potash policy to insure against unnecessary use of potash would be beneficial to both the producers and consumers of potash. The leaders of the potash industry are interested in all forms of research and promotion for wise potash usage since it will prolong the life of potash as a saleable product and as a yield booster of food or fiber.

F. Alternate Water Source for Potash Refining:

The alternative of an alternate water source would involve securing water for refineries from sources within the potash basin. This would result in pumping water from the brackish ground water in the potash basin and/or re-cycling refinery waste water, rather than importing fresh water from the Caprock Area and the Capitan Reef Aquifer.

This alternative is not considered to be within existing authority because the State Engineer controls authorizations for water sources. B.L.M. can only indirectly bring about this alternative by a restrictive lease stipulation and prohibiting the authorization of new water pipeline rights-of-way."

Submitted by Mississippi Chemical Corporation:

"As required, the EAR fully explored alternatives to the proposed action and the environmental impacts of each such alternative. In MCC's view, the EAR's consideration of alternates is adequate. MCC contends that none of the alternatives examined is more desirable than the proposed action or show that the proposed action should not be taken. With regard to the alternatives, MCC submits the following comments:

(1) No action. Under the no action alternative, existing potash operations would continue until existing leases and permits expired. No new leases or permits would be issued, and upon expiration, existing leases would not be readjusted. No new potash facilities could be constructed. The selection of this alternative would eventually result in the cessation of all potash mining activity within the study area. Such action is clearly not in the national interest. This action would compound an already severe world food shortage. All countries are being encouraged to increase their food production. Potassium is vital to accomplishing this goal. If the no action alternative is adopted, the United States would, within 20 years, be almost totally dependent upon foreign imports for its potash supplies. Our country depends largely upon food exports to maintain its balance of trade. Total dependency on foreign countries for potash would have significant adverse impact on this balance of trade. The current oil shortage has demonstrated what dependency on foreign raw materials can lead to. If we are to avoid a similar situation with regard to potash, the New Mexico deposits must be developed to the fullest extent possible.

The no action alternative is in direct conflict with the Department of Interior's stated policy of encouraging the development of mineral resources under its jurisdiction where mining is authorized. As concluded in the Report, this is not a viable alternative.

(2) Delayed action pending further study. The EAR adequately investigates and analyzes the environmental impacts of the potash industry. There is no need for further study. Further delays would only discourage further development of the potash industry within the study area. Such action would be in derogation of the stated policy of encouraging the development

of mineral resources. Delay would indirectly result in a "no action" policy, with the resulting disadvantages discussed above. These results are clearly not in the national interest.

(3) Alternate site for MCC mine shaft and refinery. Mississippi Chemical Corporation has long-range plans to construct a large, new potash refinery. Engineering work on this project is well under way. MCC's new refinery was specifically dealt with in the EAR. On January 2, 1975, Mississippi Chemical Corporation filed an application for a non-competitive lease embracing the E 1/2 of Section 9, and the W 1/2, NE 1/4 of Section 10, Township 21S, Range 30E, in Eddy County, New Mexico. MCC intends to construct its new potash refinery on this property. Prior to selecting its proposed refinery site, MCC carefully studied and evaluated the area near our ore reserve. Many factors were taken into account and the environmental impacts of the proposed plant site were of paramount importance in MCC's site selection process. The following factors were also considered by MCC and support the selection of MCC's proposed refinery site:

(a) No commercially valuable potash ore deposits underlie the proposed refinery site. The site is located along the outer boundary of MCC's ore reserves. Therefore, no valuable deposits of potash will be lost in a support pillar. The selected site fully complies with the EAR's suggested mitigation measure No. 20 (Page III-56).

(b) The proposed site is located near a very desirable disposal site for salt tailings and brine ponds. The formations underlying MCC's proposed salt tailings and brine pond area are categorized as Dewey Lake Beds which are impermeable to brine seepage. Utilization of these areas will preclude the seepage of waste water into the ground waters or the Pecos River.

(c) If the proposed site is used, construction of supporting offsites and utilities will result in minimal additional surface disturbance. The selected area is readily accesible to existing utility and transportation facilities. Tentative plans are to have natural gas supplied through a short diversion line from Southern Union Gas Company's existing line which now supplies the

Kermac Plant. An existing road which intersects Hwy. 180 and runs in a southeasterly direction toward the proposed plant site will be improved to provide ingress and egress to the proposed site. The existing road runs to within 200 yards of the selected area. Electric power will be supplied by running a short line from the existing line servicing the Kermac Plant. The proposed plant site is strategically located near an existing Santa Fe Railroad line which now services the Duval and National Plants. A spur from this line would be run to the new plant site. This accessibility to existing transportation and facilities is in accordance with recommended mitigation measure No. 13 (Page III-56). As shown above, selection of this site makes maximum use of existing facilities, resulting in the least possible disturbance of the environment.

(d) The proposed refinery site is as near as possible to the center of MCC's ore reserves. This reduces the underground problems with conveying ore from the receding mine face and ventilation at the mine face as the mine expands within the ore body.

(e) The plant site is located approximately two miles away from U. S. Hwy. 180. This was intentional. A site sufficiently removed from the public highway will diminish visual impact. Furthermore, the proposed site has a small rise between it and Hwy. 180 which will materially reduce visibility from the public highway.

The alternative of constructing the new refinery at MCC's existing refinery site was considered. It was noted in the EAR that utilization of this site would result in the involvement of less undisturbed land and thus diminish the impacts on soil, vegetation, wildlife, ecological interrelationships, aesthetics, recreation and cultural resources. It is neither technically feasible nor in the overall best interest of the environment to construct a new refinery at the existing plant site. This area is located directly over the barrier pillar which was left to protect MCC's No. 1 and No. 2 mine shafts. Some subsidence has already occurred in this pillar as a result of secondary mining done by MCC's predecessors. Due to the subsidence which has already occurred and which will continue to occur, the existing site will not furnish the stability required for a new potash refinery. A serious safety factor precludes using this site.

The pillar underlying the existing plant site contains in excess of 3,000,000 tons of the highest grade potash ore remaining in the Carlsbad potash basin. It is hoped that sometime in the future this pillar can be removed by means of a new shaft. Construction of the new refinery at the present site would preclude recovery of this ore. It is impossible to retrieve this pillar from the No. 1 and No. 2 shafts which it protects. Thus the expressed goal of maximum recovery of valuable resources would not be met.

Seventy-two acres will be required for the battery limits of MCC's new refinery. The barrier pillar underlying the existing plant site is insufficient to support a plant of this size.

As recognized in the EAR, the proposed new plant site is considered to be a better site geologically for the development of sealed brine ponds. The self-sealing red-beds are not commonly found in the area of the existing facility.

For the above reasons, MCC submits that it is not technically feasible to locate a new refinery of the size contemplated by MCC at the site of MCC's existing refinery. Careful consideration and evaluation of all alternatives supports location of the refinery at the proposed location. This was recognized in the EAR.

(4) Alternate water source for potash refineries. The potash industry does not contribute significantly to the depletion of water resources within the study area. Any reduction in water usage by the potash industry would be matched by an increase in other uses. The only alternate water source mentioned in the EAR is the Rustler Formation. MCC contends that the ground water of the Rustler Formation is not of sufficient quality for economical use in the potash industry.

Water usage and related matters are within the exclusive jurisdiction of the State Engineer of the State of New Mexico. It is therefore contended that implementation of this alternative by the BLM would represent an encroachment of that jurisdiction.

In addition to the alternatives mentioned above, the EAR explored other alternatives deemed to be outside of existing authority. Since these alternatives are not immediately available for implementation, comment on these alternatives will be deferred."

Submitted by International Minerals and Chemical Corporation:

"An alternative listed in Section 1, page I-92 suggests lease restrictions that would require leaching and crystallization in lieu of selective flotation. This is not a viable alternative for two basic reasons:

(a) Mixed Langbeinite-Sylvinite ores and/or Langbeinite ores cannot be refined using a crystallizer circuit.

(b) Substitution of crystallizers for flotation cells to refine sylvinite ores would have little, if any, effect on air emissions. In the potash industry, air emissions are derived from dryer, screen and pulverizer stacks, and from evaporators--none of which would be replaced by utilizing crystallizers."

Submitted by Carlsbad Caverns and Guadalupe Mountains National Parks, National Park Service:

"P. I-92, Alternative b.: It seems to us that this alternative assumes too much in making an assertion that 2-3 years of further data gathering and study would (definitely) result in new lease stipulations capable of providing "for more environmentally sound production of potash." This is especially true since there would appear to be no clue as to when the "2-3 year moratorium" would commence.

P. I-93, Alternative b., second paragraph makes an unwarranted statement that "this alternative would stop all environmental degradation associated with potash operations." While in truth, many types of degradation relating to such as continuing leaching from tailings and brine ponds would continue for many years, as would surface subsidence, slumping and much aesthetic degradation which would increase dramatically as properties deteriorated.

P. I-94, Alternatives d. and e. do not appear to be valid alternatives, but rather to constitute actions which may be needed not so much for any advantage in protecting the environment, but as an important part of our future Federal economic and energy policies affecting our posture in International affairs."

Issue:

The proposed action would seriously impede oil and gas exploration and development in literally hundreds of thousands of acres. The EAR does not adequately address the impact of curtailment of oil and gas activities in the potash study area. Instead of simply granting all potash lease and prospecting permit applications which have been filed, the BLM should consider granting them only where geological information indicates relatively high potential of good commercial potash ore and relatively low potential oil and gas.

Issue Raised By:

Belco Petroleum Corporation, Natural Resource Defense Council,
Office of the State Geologist (New Mexico)

The State Geologist merely pointed out the potential conflict of the potash industry with oil and gas drilling operations.

Response:

It was recognized early in the process that neither this regional EAR nor any other EAR or ES prepared on available information could resolve the conflict between potash and oil/gas development.

The decision was made to point out the conflict in the regional EAR and seek resolution through subsequent efforts. The regional EAR addresses this conflict on pages II-295 to II-298. The BLM feels that resolution of the conflict is still not possible in this document.

However, it is apparent that the potash EAR does not fully discuss the existing and potential impacts on the oil and gas resource. Therefore, substantive portions of Belco Petroleum Corporation's written comments, relating to impact on the oil and gas resource, have been included in this discussion.

With regard to resolving the conflict, it is evident that no solution will meet with universal acceptance. However, the BLM is leading a planning effort to deal with this problem and hopefully develop acceptable guidelines to at least ameliorate the situation. The BLM is working with USGS and U. S. Bureau of Mines in this effort and will coordinate with various New Mexico State Agencies and private concerns.

Submitted by Belco Petroleum Corporation:

"The closest that the Preliminary EAR comes to an assessment of the hydrocarbon potential in the Study Area is the bare statement that "oil and natural gas in commercial quantities is produced in the Study Area. Most of the oil and gas production in Southeastern New Mexico is from Eddy and Lea Counties." (Vol. II, p. 161). The Preliminary EAR contains no study of the hydrocarbon potential of the Study Area, even based on existing available geophysical and geological data concerning the region in which the Study Area is located, much less new research directed specifically at the Study Area.

Belco submits that this potential may be very substantial. Most of the oil and gas production in New Mexico, not just in southeastern New Mexico, is from Eddy and Lea Counties. New Mexico is a major oil and gas producing state, fourth in the United States in the production of natural gas and sixth in the production of crude oil in 1974. According to the NMOCC, Lea and Eddy Counties together produced three-fourths of New Mexico's crude oil and substantially more than one-half of its natural gas.

Drilling activities are an even better indicator of the future potential of the area, and in 1974 Eddy County led the entire nation in the total number of new well wildcats drilled and in total footage drilled. In 1975, there were over 700 completions in Lea and Eddy Counties, three-quarters of which were new wells. Leases bonuses in Lea and Eddy Counties are among the highest of any onshore area. These facts do not conclusively establish the extent of the hydrocarbon potential of the Study Area. But they certainly call for scientific study of this potential in an attempt to estimate its magnitude.

The Preliminary EAR discusses at some length reasons for increasing potash production, but virtually ignores the nation's continuing energy crisis. First, the BLM notes our substantial dependence on Canadian potash while neglecting our more critical dependence on much less friendly sources of crude oil. Second, the BLM notes that potash is used in fertilizer, which assists in increasing the food supply, without pointing to any present or future national food supply shortage. BLM does not mention the immediate, increasing and pressing shortage of natural gas. As reported by the Comptroller General to the House Committee on Government Operations, October 31, 1975, the FPC this fall predicted major curtailments by interstate pipelines during the current winter season, totalling 3.2 trillion cubic feet. Actual curtailments have apparently been at a somewhat lower level, thanks to unseasonably warm weather, but the threat continues. Such shortages, especially if combined with unseasonably cold weather and/or shortages of alternative fuels, can substantially reduce industrial production levels and associated employment. Even when available, alternative fuels such as fuel oil or propane cost three to four times the price of interstate natural gas.

Considerations such as these certainly indicate that proposals to increase the scope of potash operations in the Study Area must be weighted against the best obtainable estimates of the oil and gas production that would be lost or delayed."

Issue:

The Maroon Cliffs site for the proposed MCC refinery contains high wildlife and archaeological values. Alternative sites should be studied.

Issue Raised By:

Daniel Washburn, Central New Mexico Audubon Society, C. A. Hundertmark, State Historic Preservation Officer, U. S. Fish and Wildlife Service, Director, Division of Natural Resources, State Planning Office

Response:

The Regional EAR analyzed the potential impacts of the proposed site and pointed out the conflict with wildlife and archaeological values. In addition, the EAR also generally discusses alternative sites for the proposed refinery.

As stated on page III-52 of the Regional EAR, individual environmental analyses will be prepared on specific actions as they are proposed. One such specific analysis will be on the proposed MCC refinery. When more information is developed by MCC, an intensive EAR will be produced which will study alternatives and specific mitigating measures to avoid or minimize environmental impacts. This individual EAR will supplement the findings and analysis contained in the Regional EAR.

Issue:

The BLM and USGS should assess the extent and importance of land use activities that would be prohibited in order to assure the integrity of a potential radioactive waste disposal facility within the Study Area. This assessment should consider the potential loss of potash and oil/gas resources; and also consider the needed restrictions on oil/gas and potash mining near the proposed repository.

Issue Raised By:

Natural Resources Defense Council

Response:

A general discussion of the proposed atomic-waste facility is given in the Regional EAR on pages II-298 to II-300. No specific site has been proposed pending studies to determine geologic, hydrologic, and other conditions to accommodate such a facility. These current studies being conducted by the Energy Research and Development Administration (ERDA) are also designed to determine potential loss of potash and oil/gas resources as well as other conflicts.

ERDA is also preparing an environmental impact statement on the proposed facility to fully analyze all environmental consequences. This ES is being developed in consultation and coordination with the Department of the Interior.

In addition, the BLM and USGS are working with ERDA to develop any appropriate restrictions on all types of drilling to protect the integrity of potential A-Waste sites. Therefore, the issue raised

is being adequately and appropriately covered in the current studies, including an ES. Consequently, the issue is not within the scope of the Potash Regional EAR.

Issue:

The regional potash EAR does not sufficiently reflect the socio-economic benefits derived from the potash industry in New Mexico. In addition, the economic impacts of the various alternatives are not addressed.

Issue Raised By:

Southeastern New Mexico Economic Development District, Eddy County Board of Commissioners, The Atchison, Topeka and Santa Fe Railway Company

Numerous individual and organization comments reflected the opinion that socio-economic benefits of the potash industry should be given more weight in the EAR and subsequent decisions.

Response:

The BLM feels that the discussion adequately covers the socio-economic impacts of the proposed action. It should be pointed out, however, that BLM and Department of the Interior guidelines do not call for intensive analysis of economic factors, (such as benefit/cost analysis), in environmental reports. These economic considerations are recognized in the decision making process along with environmental factors, political considerations, etc. Regional and community economic factors play an important part in BLM's decision making process.

Issue:

The BLM is in error in stating on page II-254 of the EAR that the State Historic Preservation Officer is preparing the nomination of the Maroon Cliffs area for placement on the National Register.

Issue Raised By:

New Mexico State Planning Office

Response:

We agree. The BLM District Office will prepare the nomination.

Issue:

P. II-303: Under cultural resources, it is stated that between 18,000 and 23,000 archaeological sites are to be found within the study area, but this statistic has little meaning when unaccompanied by a rather precise definition of the term archaeological site.

Issue Raised by:

National Park Service

Response:

See the Glossary Corrections page of this supplement for a new definition of Archaeological Site.

Issue:

There are a series of three separate statements regarding cultural resources which are, to some degree, either misleading or false, if we can assume that the definition of Archaeological Sites given in

the Glossary is also the working definition guiding site identification during the archaeological fieldwork. The first of these is to be found in the paragraph starting at the bottom of P. III-129 and concluded on the following page:

"Cultural values, even when salvaged, are destroyed. The very act of salvage involves the destruction of the site context. The information gained is limited by the techniques presently available. The development of a better technique at a later date is of no use once the site has been excavated since only materials of present informational value are saved. The site context is gone and no further information can be gained."

The second statement occurs as the second sentence of the last paragraph starting on P. III-130 and concluded on the following page:

"Even when a site is salvaged, its potential for yielding further information is destroyed."

The final statement in comparable vein constitutes the second paragraph under "Cultural Resources" on P. III-134:

"Any sites mitigated by salvage rather than avoidance, are also irreversibly lost, since they will be destroyed in the process of salvage and will not be available for future research."

Each of these statements strives for the ring of absolute and universal truth to the effect that not only any site, but all sites and their cultural values are totally and irretreivably destroyed by salvage. In contrast, the range of archaeological sites covered

by the definition in the Glossary would assuredly include a great many "deflated sites" in which the assemblage of artifacts that would "constitute" the site, had come to rest on an erosional surface from previously existing higher strata which might well have embraced several distinctly different cultural and/or chronological horizons. Any recorded "site" in which such might be the case already is totally lacking any "site context" as that term is used in the first of the three statements above!

Certainly, a significant number of the "sites" to be found in this physiographic province characterized by aridity and soil loss through sheet erosion and gullyng, will have a totality of "values" consisting of artifacts totally lacking any interrelationship outside their coincident existence in space at the moment of discovery. All of this value will be salvageable and completely available for future research if adequate care is taken during the salvage work."

Issued Raise By:

National Park Service

Response:

A deflated site does provide information especially of an environmental character - i.e. the area has eroded (indicating desiccation) since the site was established. The archaeologist can gather data from such sites. The knowledge gained in such cases is less than if the erosional episode did not occur, however, systematic excavation of a site is an entirely different thing. In such a case all possible information is gathered and the site is

not disturbed by natural actions (which in themselves may be informational) but is systematically dismembered for information. In such a case materials are not merely mined or shifted in a traceable manner, but are removed great distances, i.e. to a museum. When a site is excavated for academic purposes, parts of the site are often left intact; but, in a salvage situation a site is salvaged because it is about to be destroyed by some other action. In such a case it is entirely appropriate to state that site salvage involves site destruction because any material left after salvage is destroyed by the activity that prompted salvage. An adequate salvage job would gather all of the site information available.

Issue:

If subsidence damages a state highway, is the state absorbing the cost of repair or is the industry reimbursing the state for such damages?

Issue Raised By:

State Planning Office

Response:

The New Mexico State Highway Department at Carlsbad, New Mexico advises us that subsidence damage is repaired as a part of the normal and routine road maintenance because subsidence damage is not clearly separable from normal wear and tear on the roadway. Special or extraordinary maintenance measures are not taken. The expense of road repairs is borne by the Maintenance Fund.

Issue:

P. II-196. "Therefore, if this Saline water is being polluted with brine effluent at places, returning it to the pristine condition will achieve scarcely any economic benefit." Whether or not this statement is entirely accurate, "economic" benefit is not the only concern. Would other benefits accrue by returning ground water to its pristine, albeit saline condition?

Issue Raised By:

Sierra Club

Response:

Because these fluids contain high concentrations of dissolved solids, they are not usable. The only value in these waters is the potassium content and therefore waters with high potassium content are likely more valuable than those with low potassium content. Other benefits which might accrue are not known.

Issue:

On page III-91 should be given also the price per ton of potash as it has varied over the last five or six years. This would allow one to put the control costs of 30¢ - 60¢ per ton into some perspective.

Issue Raised By:

New Mexico Citizens for Clean Air and Water

Response:

The average value per ton of domestic sales of potassium salts by producers reported by the U. S. Bureau of Mines is:

Response to CommentsMiscellaneous

<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u> ^{1/}	<u>1975</u> ^{2/}
\$19.64	\$22.30	\$22.50	\$23.92	\$33.69	\$49.26

The value per ton (gross weight of marketable potassium salts divided by value) of potassium salts sold or used by New Mexico producers as reported by the U. S. Bureau of Mines is:

<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>
\$19.74	\$21.78	\$21.98	\$23.34	\$32.44	\$46.76

Issue:

Page I-(5), Background, paragraph three, Sylvite is KCl only. The mineral Sylvinite KCl NaCl should be used throughout the EAR.

Page I-(4), d. defining lines four and five. Contaminated with 60 to 75 percent halite - same comment as I-(5) above. The great majority of the potash ore is Sylvinite, KCl NaCl.

Issue Raised By:

U. S. Geological Survey (USGS)

Response:

Early in the preparation of the EAR it was decided to refer to the ore and gangue along strict mineralogical lines as a simplifying aid in communication to the many readers having widely diverse backgrounds. We recognize that "sylvinite" is in general use among those knowledgeable of and experienced in the operations of the Carlsbad potash basin.

1/ Revised

2/ Subject to revision

Issue:

Page I-(13), paragraph two. The wireline procedure may cause damage to core recovery. The bit and core barrel are pulled on 20 ft. runs, a general rule.

Issue Raised By:

U. S. Geological Survey

Response:

Although the wireline system is available, the pulling of the entire drill string at the end of each run is a preferred method of core recovery.

Issue:

Page I-(36), paragraph two. "Ore haulage in the potash mines is by conveyor belts." Extensive rail haulage of ore has been used in the Carlsbad Mining District. This should be considered typical also.

Issue Raised By:

U. S. Geological Survey

Response:

At the present time, most ore mined in the district is transported by conveyor belts. However, rail haulage is still used in one mine to augment belt haulage and rail haulage has been widely used in the past. Rail haulage is a typical method of ore haulage in the district.

Issue:

Page I-(10), par. 2, Exploration. Although the Typical Potash Operation recognizes the need for heavy plastic liner material for sump pits containing brine liquids and oil bearing liquids used during drilling to prevent soil contamination, an appropriate statement should be included to indicate that the heavy plastic liner is also to prevent contamination of shallow potable ground water sources that may occur in the area.

Issue Raised By:

U. S. Geological Survey

Response:

We concur, the purpose of the liner is to insulate the earth from contact with the drilling fluids thus preventing fluid infiltration into soils, rocks, and water-bearing intervals in the subsurface.

Issue:

Page I-(48), Step 10, Refining, Tailings Disposal. Typical Potash Operations indicates that waste sodium chloride brine and magnesium chloride brine are impounded and evaporated in unlined tailings ponds. Measures to prevent contamination of water resources resulting from percolation to ground water sources and overflows to surface-water sources from tailings disposal sites should be considered.

Issue Raised By:

U. S. Geological Survey

Response:

These measures are discussed on pages III-54, 55, 59, and 124.

Issue:

Tables I-3 and I-4, and in several areas from page I-(70) on, the term "commercial quantities" has been used incorrectly in place of the term "valuable deposits."

Issue Raised By:

U. S. Geological Survey

Response:

All deposits can be termed "valuable", however, only some are in such a quantity to merit "commercial" designation.

Issue:

Page I-(79), I-(80), and I-(81), 2. a. Mississippi Chemical Corporation. This description of MCC does not mention their potash ore development plans in the seventh and fifth ore horizons. The development of these two ore horizons are the primary development objective of MCC. The tenth ore horizon is lower grade and only a part of their proposed program.

Issue Raised By:

U. S. Geological Survey

Response:

The mining and reclamation plan of the Mississippi Chemical Corporation was received after preparation of the EAR was well underway. Thus, this plan is not reflected in the EAR.

Issue:

Figure II-2 through Figure II-35. What is the source of this air quality data? Is it interpretational data or was this done by

government personnel or a contractor? There are several unmarked figures and tables that do not properly indicate source in the air section.

Issue Raised By:

U. S. Geological Survey

Response:

See the air tables and figures in the Residual Impacts section of this supplement.

Issue:

Page II-(191), par. 3, and page II-(191), par. 5. In order to adequately assess the occurrence of a shallow saline aquifer above the brine aquifer in the vicinity of the brine lakes, Laguna Tres and Quatro, and the relationship between the ephemeral occurrence of water in the shallow saline aquifer and the present (1975) flooded Nash Well by Laguna Quatro, substantially more hydrogeologic data would be required. Such data should include water-level measurements, well-log data, and chemical quality of water from each aquifer.

Issue Raised By:

U. S. Geological Survey

Response:

To prove the statements beyond all doubt and to quantitize the nature of these aquifers and waters, substantially more hydrogeologic data would be required.

Issue:

Page II-(298), paragraph six. There are some salt brines occasionally reported in conjunction with potash mining operations.

Issue Raised By:

U. S. Geological Survey

Response:

These salt brines are small pockets of saturated brine, more or less residual in origin. Their occurrence and the quantity of brine involved have essentially no effect on hydrologic analysis and conclusion. However, the point is well taken in that there are no regions which have "no water" and even the salt beds are not "absolutely dry."

Minor Changes Section

This section is a compilation of text changes for the Regional EAR, additional information for the EAR, and miscellaneous comments concerning the content of the document. Each item is in page order so that ready reference can be made between this section and the EAR.

I-5, Appendix E-3
Background
Table of Surface and Subsurface
Land Ownership in Acres

The EAR does not contain figures of the State of New Mexico's subsurface mineral rights. In that regard, the following was submitted by the New Mexico Commissioner of Public Lands.

The Bureau of Land Management's Environmental Analysis Record of Potash Leasing in Southeastern New Mexico on Page I-(5), and Appendix E-3 indicates that the State of New Mexico owns 167,809 surface acres of land in the study area covered by the report. The report does not appear to contain a total figure of the State's ownership of subsurface mineral rights. The State Land Office records show that the office of the Commissioner of Public Lands now has 112,548 acres of active state potash lease status in the area covered by the report. These leases are held by eight presently active potash companies now operating in the Carlsbad area and several other companies and individuals. Our office now has, on a temporary pending status, nomination requests for potash lease sale of an additional 106,644 acres of State sub-surface mineral rights in the Study area.

I-59
State and Local Roles
Environmental Improvement Agency

Original text contains the following statement describing the role of the Environmental Improvement Agency.

The role of the New Mexico Environmental Improvement Agency (EIA) is to enforce air quality standards and water quality standards under the New Mexico Air Quality Control Act of 1967, as amended, and the New Mexico Water Quality Standards Act approved August 21, 1969. The EIA has full delegation of authority from the Environmental Protection Agency (EPA) to administer the water pollution control program and the air quality control program. EIA also has responsibilities and jurisdiction over the production of the finished product under the Occupational Safety and Health Act.

This is corrected as follows:

The New Mexico Environmental Improvement Agency (EIA) is organized within the New Mexico Health and Social Services Department and is responsible for environmental management and consumer protection.

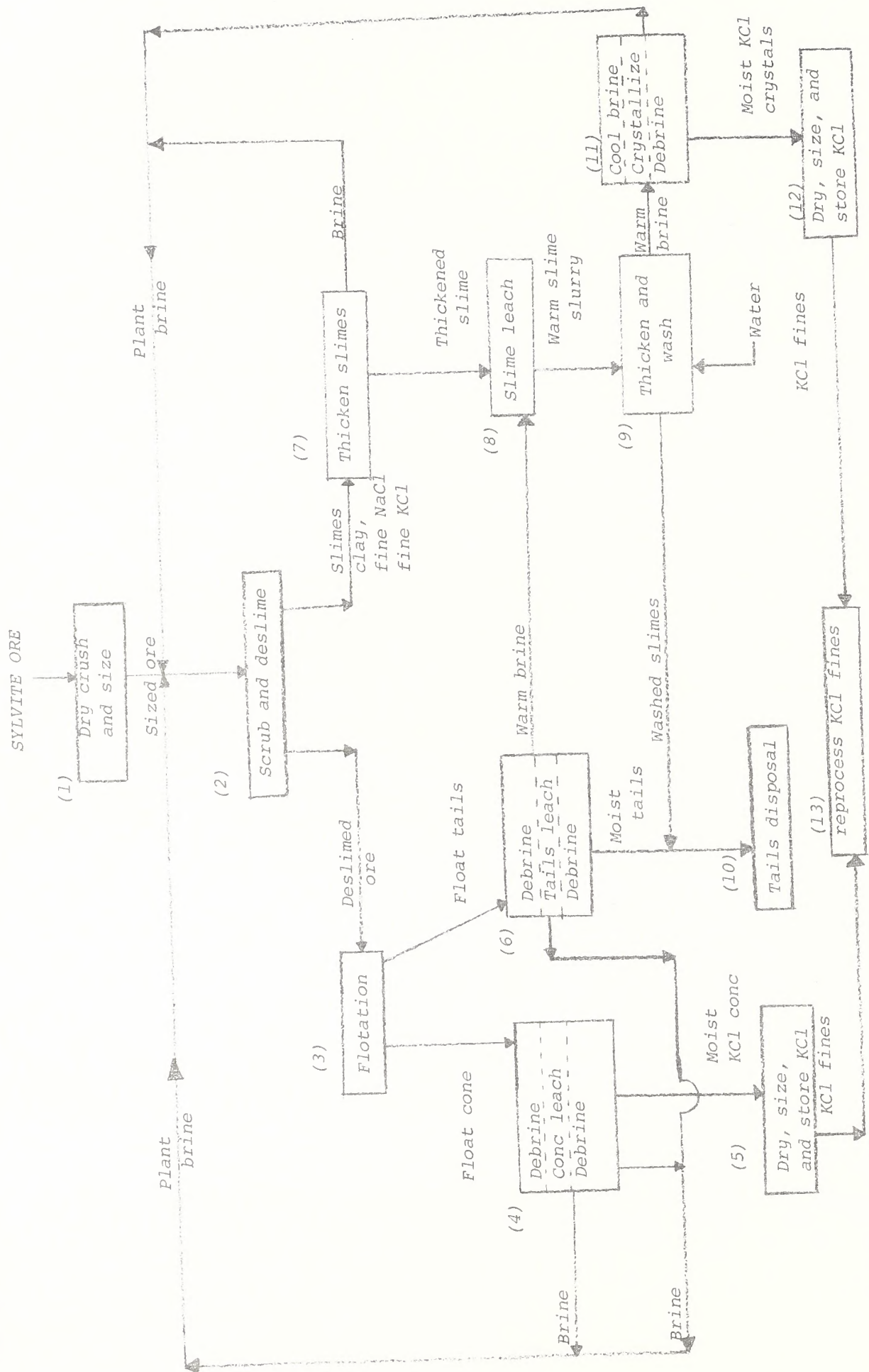


FIGURE I-12 Sylvite Ore Flowsheet

In air pollution control the EIA administers standards and regulations adopted by the Environmental Improvement Board under authority of the New Mexico Air Quality Control Act. In water quality control the EIA administers standards and regulations adopted by the Water Quality Control Commission under authority of the New Mexico Water Quality Act. EIA also has responsibilities and jurisdiction over the safety and health of employees in the work place under the Occupational Safety and Health Act.

The legal reference to the water law should be corrected to read: "New Mexico Water Quality Act of 1967, as amended." The role of EIA includes enforcement of regulations. The EIA does not have delegation of authority from the Environmental Protection Agency (EPA) to administer the water pollution control program.

I-77

Interior Department Procedures
Mining and Reclamation Plan

Once a lease has been issued, the lessee must submit a mining and reclamation plan to the USGS Mining Supervisor before any operations can be conducted. The plan essentially must provide for efficient utilization of minerals, for protection of non-mineral resources and for the reclamation of land surfaces affected by the operations. The Mining Supervisor prepares an environmental analysis on a mining and reclamation plan to determine if lessee operations will significantly affect the environment. If this is the case, an Environmental Impact Statement (EIS) is prepared jointly by USGS and BLM; if not, the plan may be approved under existing laws and regulations.

This paragraph is corrected to read as follows:

Once...environment. The environmental analysis is also submitted to BLM for concurrence. If the lessee operations will significantly affect the environment, an Environmental Impact Statement (EIS) is prepared jointly by USGS and BLM; if not, the plan may be approved under existing laws and regulations.

I-83

Company Proposals
International Minerals Corp. (IMC)

In item 3 IMC proposes "replacement of the present Ozark evaporators with triple effect evaporators."

Relating to this, IMC has submitted the following:

References to the ozark evaporators appear to assume that the final decision to replace the evaporator has been made by IMC. Recent changes in long-range planning and factors revealed by expansion feasibility studies have required re-evaluation of the project. These studies are as yet incomplete.

I-84

Company Proposals
Duval Corporation

The following paragraph appears in the original text.

Duval Corporation is planning to expand their langbeinite refinery depending on future market conditions for potash. Such an expansion would require an additional source of water. Duval claims that a 20 percent salt-saturated water solution can be used for leaching in the langbeinite process and the company is considering obtaining the water from the Capitan Reef Aquifer below 2,500 feet.

The following information was submitted by the State of New Mexico Engineer's Office.

No permit is required from the State Engineer for wells drilled to appropriate water from an aquifer, the top of which aquifer is at a depth of 2,500 feet or more below the ground surface and which aquifer contains non-potable water (not less than 1,000 parts per million of dissolved solids). However, any person proposing to appropriate such water must comply with the provisions of notice, publication and reporting required by Sections 75-11-38 and 75-11-39 NMSA 1953 Comp.; and any person seeking to appropriate water containing less than 1000 ppm dissolved solids must have a permit from the State Engineer. Appropriations from the Capitan Reef Aquifer, regardless of the concentration of dissolved solids, could have an adverse effect on the Carlsbad Springs and thus impair existing rights. You may wish to consider including in the record some discussion of these points.

I-92

Alternatives

Leaching and Crystallization Refining Process.

This process was considered because it was originally thought that the leaching and crystallization process involved less

air pollution than the other refining processes. Subsequent investigations have been inconclusive regarding this process and resultant air pollution.

I-94

Alternatives

The following, submitted by USGS, is added to the National Potash Policy alternative.

Potash has over 500 uses of which fertilizer for food production is considered to be one use. Several of the potash uses involve chemicals for the munitions industry that are critical for national defense.

I-95

Alternatives

Alternate Water Source

Original text includes the following paragraphs.

The alternative of an alternate water source would involve securing water for refineries from sources within the potash basin. This would result in pumping water from the brackish ground water in the potash basin and/or recycling refinery waste water, rather than importing fresh water from the Caprock Area and the Capitan Reef Aquifer.

This alternative is not considered to be within existing authority because the State Engineer controls authorizations for water sources. BLM can only indirectly bring about this alternative by a restrictive lease stipulation and prohibiting the authorization of new water pipeline rights-of-ways.

The following discussion was submitted by the New Mexico State Engineer.

At page I-95 the report suggests that BLM could bring about the use of alternative water sources by restrictive lease stipulation and prohibiting the authorization of new water pipeline rights-of-ways. There appears to be some possibility that such lease restrictions or denials of rights-of-way could prevent development that would otherwise be practicable and could even have a serious impact on investments already made. Some discussion in the record of these ramifications of restrictive lease and rights-of-way provisions might be useful.

II-1
Air
Climate

The following information regarding rainfall in the vicinity of the potash refineries was submitted by Les H. Bates, rancher.

In my opinion, rainfall on my ranch has been increased by the minute particles of potash which have been discharged into the atmosphere by the potash refineries, and which in my opinion act as a rainmaking agent which in my experience has been considerably more effective than silver iodide cloud seeding which was tried in the area some years ago by Dr. Irving P. Krick to whom myself and other ranchers paid several thousand dollars.

The rainfall on my ranch has consistently averaged from 150% to 200% of the rainfall in Carlsbad where I reside as shown by rain gauges at my Carlsbad home and at the ranch.

II-6
Table II-3

Correct reference date for Table II-3 is from Potash Company of America Refinery Records, 1975.

II-47
Table II-33

Table II-33 should be referenced as follows:

From State of New Mexico Implementation Plan for Federal
Primary and Secondary Ambient Air Standards, January, 1972.

II-49
Table II-34

Table II-34 should be referenced as follows:

From State of New Mexico Implementation Plan for Federal
Primary and Secondary Ambient Air Standards, January, 1972.

II-50ff

Table II-35 through Table II-42

These tables should be referenced as follows:

From National Emission Data System (NEDS) 1972 record.

II-68

Nonliving Components

Air

In paragraph three reference to Appendix A-2 should be Appendix A-4.

II-58ff

Table II-43 and II-44

These tables should be referenced as follows:

From National Emission Data System (NEDS).

II-71ff

Figure II-2 through II-35

These Figures should be referenced as follows:

From Computer Dispersion Model, University of Oklahoma, 1975.

II-105, 106

Tables II-49 and II-50

Tables identified as II-49 and II-50 should be reversed. In addition, all figures of 1000 on page II-105 should be preceded by the symbol > (greater than).

II-123

Land

Soils

Original text includes following paragraph.

Soils of the Carlsbad Potash Area are delineated into 6 soil

groupings in this study and will be referred to as Groups I through VI. Appendix, A-8 contains a listing of individual soils identified by groups for the study area. These soils have developed under mixed shrub and grassland vegetation common to the semi-arid continental climatic conditions of the Southern Desertic Basin and Plain. As a result of prevailing climatic and vegetative conditions, many soils have developed with a light colored surface. Subsoil colors normally are light brown to reddish brown, but are often mixed with white lime accumulations, which result from limited, erratic rainfall and insufficient leaching. Most soils of the study area have developed from wind worked material of mixed origin and/or in old alluvium derived from sedimentary rocks.

The Soil Conservation Service suggested the following addition.

Typical profiles of Kimbrough, Cottonwood, Reeves, Bernio, Largo and Midessa soil series representing the Groupings I through V are found in Appendix A-8. Playas represent Group VI.

II-151

Land

Mineral Resources

The following sentence appears in the fourth paragraph.

Cross hatched areas on Map II-4 show the known limits and distribution of economic potash resources (ores) in the Carlsbad Mining District.

This is corrected to read as follows.

Map II-4 shows the known limits and distribution of economic potash resources (ores) in the Carlsbad Mining District.

II-168

Water

Water Supplies of the Potash Industry

Original text contains the following.

Water used in mining and refining operations, is obtained principally from wells in the declared Lea Country and Carlsbad

underground water basins. One company has used water from the Pecos River. These sources of water are under the jurisdiction of the New Mexico State Engineer. Unappropriated water is still available in parts of the Lea County underground water basin, but water in the Carlsbad underground water basin and from the Pecos River is fully appropriated. Attempts to develop adequate supplies of water from the Rustler Formation have not been successful so far. Requests to obtain new appropriations of water from the Capitan Limestone of the Capitan underground water basin have been denied by the State Engineer on the grounds that impairment of existing rights would occur. In view of this situation, ground water in the Lea County underground water basin continues to be the best source of water for use by the potash industry. Procurement of additional water rights in the Lea County underground water basin would be in competition with agricultural, municipal, and commercial uses.

The New Mexico State Engineer submitted the following discussion.

The report discusses water supply of the potash industry at pages II-168 and II-169. You may wish to consider including the amount of water each company is entitled to appropriate from the Lea County Underground Water Basin under permits from the State Engineer. There is attached a summary of the appropriations permitted to each company. The summary also includes the 1974 diversions made under these permits and a list of water rights from other sources.

II-186

Water

Lakes and Brine Springs

In last paragraph, reference to Table II-63 should be changed to II-65.

II-203ff

Living Components

Aquatic Wildlife

The following information was submitted by Central New Mexico Audubon Society.

The Check-list of the Birds of New Mexico should be consulted for information on the birdlife in the area. This source is

SUMMARY OF POTASH WATER RIGHTS

LEA COUNTY UNDERGROUND WATER BASIN

<u>Company</u>	<u>Permitted Amount Acre-feet/year</u>	<u>1974 Appropriation Acre-feet</u>
Mississippi Chemical Corporation	3,500	0
Potash Company of America Division Ideal Basin Industries	3,950	1,346
Duval Corporation	2,557	1,758
AMAX Chemical Corporation	3,972	1,993
National Potash Company	4,830	1,137
Kerr-McGee Chemical Corporation	<u>3,810</u>	<u>2,865</u>
TOTAL	<u>22,619</u>	<u>9,099</u>

WATER RIGHTS FROM OTHER SOURCES

<u>Company</u>	<u>Source</u>	<u>Amount</u>
Mississippi Chemical Corporation	Pecos River	5,356.7 Acre-feet/year
Mississippi Chemical Corporation	Carlsbad Underground Water Basin	Unknown (2 wells)
AMAX Chemical Corporation	Carlsbad Underground Water Basin	1,855 Acre-feet/year
International Minerals Corporation	Carlsbad Underground Water Basin	4,000 gpm

more up-to-date and reliable than Ligon. The Check-list of the Birds of New Mexico was published in 1970 as publication number 3 of the New Mexico Ornithological Society. The author is John P. Hubbard.

II-206ff

Living Components

Terrestrial Wildlife

The Terrestrial Wildlife Section is corrected as follows.

The Study Area provides habitat for 168 species of terrestrial wildlife; 42 mammals, 94 birds, and 31 reptiles. Invertebrates are present but very little is known about these life forms. See Appendix B-3 for a complete list of Terrestrial Wildlife species.

None of the mammals or reptiles found in the Study Area appear on New Mexico's list of endangered species and subspecies or the U. S. Fish and Wildlife Service "United States List of Endangered Fauna," May, 1974. Of the birds inhabiting the study area, eight are on the federal list and one is on the state list. The southern bald eagle and the peregrine falcon, both classified as Endangered on the federal list, probably migrate through the Study Area in winter.

McCown's longspur, classified as Endangered on the New Mexico list, is found in the Study Area during the late fall and winter. Ligon (1961, p. 305) reports that there are no nesting records of McCown's longspur for the State.

The major game mammals within the Study Area are antelope and mule deer. There is only a small, scattered population of these species, and the Study Area is considered as marginal habitat for deer and antelope. Mule deer are found in and around Nash Draw, which provides better cover than usually available in the area, because of the more rugged terrain. White-tailed deer have been reported in the area in the past; however, no recent sightings have been recorded. Most of the mammals found in the Study Area are rodents. The most abundant species are spotted ground squirrels, ord kangaroo rats, and grasshopper mice. A study was initiated to compare the relative abundance and species composition of rodents around three refinery sites compared to a control area in a similar soil type.

The data did not clearly indicate that there is a difference in rodent population levels between areas and the control areas. The reasons for this could be as follows: (1) There is no real difference, (2) The sample size was too small (1000 trap nights total), (3) Trapping was done around only 3 of the 7 refineries.

The results from the areas around the refineries indicated a decrease in the rodent population at IMC and Kerr-McGee and an increase at AMAX (Table II-66). The rodent population at AMAX was 2.5 times greater in the refinery area than in the control area.

The AMAX and IMC data indicated that spotted ground squirrels were the most abundant species in the refinery areas. The ord kangaroo rat was the most abundant species in the control areas of AMAX and IMC.

At Kerr-McGee, the small rodents such as the grasshopper mouse and deer mouse were the most abundant. These species usually do not burrow as deeply as the larger species, as evidenced by the shallow soil type near Kerr-McGee. This shallow type soil also appears to support a lesser population of rodents than the deeper soils.

The following mammalian predators are found in the Study Area: coyote, bobcat, kit fox and gray fox. These species are found year-long with the coyote being the most abundant. Rodents are their primary source of food.

The Study Area also provides habitat for several predatory birds which live off the rodent population. Year-round resident raptors include the great horned owl, red-tailed hawk, Harris' hawk, and the golden eagle. The great horned owl is one of the most widely distributed birds of the state. It is one of the earliest birds to nest and often chooses to nest in deserted hawk or raven nests in hackberry trees or large yuccas. However, their preferred nesting sites are pockets or crevices in rock cliffs or canyon walls. (Ligon, 1961)

Swainson's hawks nest in the Study Area, utilizing open country where trees are scarce. Their nests are found in such trees as cottonwood, hackberry, mesquite or any other tree (Ligon, 1961, pg. 66). The red-tailed hawk may also utilize part of the Study Area for nesting purposes. Generally this species will choose larger trees, such as cottonwoods along

water courses or in canyons (Ligon, 1961, p. 65). The Study Area encompasses some of the principal nesting sites in hackberry, native chinaberry trees, cottonwoods, tree-sized mesquite and taller bunches of squawbush (Ligon, 1961, p. 71). The Study Area is also within the year-round range of the golden eagle. Conversations with various people who are familiar with the area, indicate that a small population of golden eagles has been observed in the Study Area during the winter months.

Some bird species were observed in close proximity to the refineries. However, very few bird nests were observed nearer than approximately one-quarter mile from a refinery site, even though nesting sites were apparently available.

The major game bird species within the study area are scaled quail and mourning dove. These two species are well distributed over the area and support the bulk of the upland hunting opportunities. According to New Mexico Department Game and Fish personnel, the quail and doves utilize some of the natural lakes for drinking water.

II-216

Human Environment

Aesthetics and Recreation

The following elaboration of quail-hunting opportunities was submitted by Harold J. Trinder.

One phase of the Potash EAR hearings that has not been discussed is the effect on birds and wildlife.

I have hunted this area from Kerr-Mac through the IMCC properties as far west as the railroad at Loving for the past twenty five years.

My observations are that no significant damage has been done to birds and wildlife through potash operations during this period.

This is a quail hunters paradise with many covies containing as many as sixty birds and this has not varied much from year to year except during periods of unusual weather such as was experienced during September of 1974 when 18 to 20 inches of

recorded rainfall was common to most of the area. This excess caused the loss of nearly all of the quail population.

Drought years also have a marked effect on bird population.

At this time of year when tree foliage is at a minimum, a drive in this area will expose hundreds of last summers nests of songbirds.

II-237

Human Environment

Transportation Safety

In last paragraph, reference to Map II-10 should be changed to I-1.

II-284ff

Human Environment

Socio-Economics

Original text includes the following paragraph:

Closely tied to and flowing from the prevailing life-style of an area, community attitudes provide an indication of the goals and objectives of a given community. While vital to the planning and decision-making process information on community attitudes is difficult to obtain. In an attempt to get a measure of the public attitude toward land use, in the Study Area, and the public's expectations regarding the ability to pursue a desired lifestyle, the Bureau of Land Management solicited comments from various groups and organizations in the area. Responses were received from 34 groups or organizations, about one-fourth of the total requests mailed (See Socio-Economic Appendix for copy of request and response received). As this Environmental Analysis progresses through the public participation phase, additional comments concerning community attitudes will be received and incorporated.

The request and response referenced here is not included in the Potash EAR or in this supplement. Any persons wishing to review these items may do so at the Bureau of Land Management, New Mexico State Office in Santa Fe (Federal Building and Post Office).

II-299

Land Use

ERDA

The following information, submitted by USGS, is added to the discussion of Atomic Waste disposal in the Study Area.

The proposed ERDA site involves a portion of the Secretary's Potash Area, the NMOCC R-111A area as amended, some potash leases and many oil and gas leases. Also, the salt section is known to contain several types of gases.

II-317

Potash Operations

IMC

Original text has the following sentence under Archaeology.

Other sites are suspected in the vicinity of Salt Lake, but have not as yet been identified.

This should be corrected to read.

Other sites are suspected in vicinity of the brine pond, but have not as yet been identified.

II-351

Potash Operations

Cumulative Support

In paragraphs four and five, references to Table II-85 and Table II-86 should be changed to Appendix D-4 and Appendix D-5 respectively.

III-7

Anticipated Impacts

Water

Original text includes the following paragraph.

Potash lease abandonment will impact water use beneficially since the water used for refinery operations will stop. This is judged

to be a long term beneficial impact since the water supply, assuming one remains, will then become available for other more beneficial uses.

The last sentence is corrected to read as follows.

This is judged to be a long term beneficial impact since the water supply will then become available for other uses.

III-7

Anticipated Impacts

Land

The following elaboration of environmental impacts on soil was submitted by Harold J. Trinder.

The greatest damage to surface areas seems to be caused by pipelines where the top soil has been removed and caliche predominates. Very little growth ever returns due to the loss of topsoil.

One answer to this would be to require that topsoil be bladed aside and returned after the pipeline has been laid.

III-46

Alternatives

Alternatives (b)(2) and (c)(1), Delayed Action, differ from each other in that (b)(2) is a three year delay pending studies which are within BLM authority; and (c)(1) is a ten year delay pending legislative action outside BLM authority.

III-48

Alternatives

Alternative (b)(4), Alternate Water Source for Potash Refinery should be placed under "Alternatives and Their Impacts Outside Existing Authority" (c)(5) on page III-50. Alternative (c)(5), Leaching and Crystallization Refining Process should be placed under "Alternatives and Their Impacts Within Existing Authority" (b)(4) on page 48.

III-91

Mitigating Measures

Air

The estimated additional annualized capital costs for meeting the 30-day ambient air standard is \$250,000 rather than \$25,000.

III-99

Figure III-9 through III-27

These figures should be referenced as follows.

From Computer Dispersion Model, University of Oklahoma, 1975.

III-124

Residual Impacts

Water

Original text includes the following paragraph.

Lease abandonment will have residual beneficial impacts in that the water used by the potash industry will be available for more beneficial uses, and the risk of polluting the Pecos River should decrease when the refineries cease adding brine to the environment.

The paragraph is corrected as follows.

Lease abandonment will have residual beneficial impacts in that the water used by the potash industry will be available for other beneficial uses, and the risk of polluting the Pecos River should decrease when the refineries cease adding brine to the environment.

III-136

Irreversible and Irretrievable

Commitments of Resources

Loss of Land

Add Item 9, Primitive and Wilderness Values, as suggested by the Sierra Club.

Because there are no primitive and wilderness values in the Study Area, these values were considered and dismissed.

III-135

Irreversible and Irretrievable

Commitments of Resources

Loss of Human Life

The following elaboration of Loss of Human Life was submitted by
E. Lloyd Upton.

I had the opportunity to study the written report prepared by your staff and there is one excerpt which I would like to make specific comment on; regarding section III-135, paragraph seven. Fatal accidents occur in all industry, not just potash mining. The mention of "possible murder and suicide as a result of increased human interaction from population increases has gone beyond the limits of logical thinking. It is true that where there are no people, there is no crime, but the world population is steadily increasing and so is crime. This is a fact of life and is not justification for closing down the potash mines or any other industry. There was mention of four fatalities each in 1973 and 1974. I'm sure that the statistics can be made available for other years which will prove the potash mines are among the safest in the entire mining industry. Any loss of life anywhere constitutes an irreversible and irretrievable loss of human resources whether it be in the mines, on the highways or in airplanes, but we can't close all the highways, mines and airports to keep someone from getting killed. Fatal accidents anywhere are abhorrent and must continually be studied and reduced through research, education and continued effort on the part of everyone.

IV. Persons, Groups, and Government Agencies Consulted

Lea County Archaeology Society should be changed to Lea County Archaeological Society.

VI. Participating Staff

List of Participating Staff is corrected as follows.

Bob Barnes New Mexico Reporting and Research Service	Contract Copy-Editor
Paul Bodenberger Bureau of Land Management	Environmental Analyst Writer
Donald Calhoun Bureau of Land Management	Surface Protection
Larry Canter, Ph. D. University of Oklahoma School of Civil Engineering	Contract Air Specialist
Mike Chavez Bureau of Land Management	Graphics
Georgia Davis Bureau of Land Management	Typist
Dennis Erhart Bureau of Land Management	Leader, Environmental Coordination Section
Charles Godfrey Bureau of Land Management	Aesthetics, Recreation, History
Stella Gonzales Bureau of Land Management	Lands Adjudication
Ted Graf Bureau of Land Management	Writer-Editor
Maureen A. Halloran Bureau of Land Management	Graphics
Carol O. Herron Bureau of Land Management	Writer-Editor
Homa King Bureau of Land Management	Typist
Doyle Kline Bureau of Land Management	Public Affairs

William Leifeste
Bureau of Land Management

Vegetation Specialist

Ann Loose
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Archaeology, Paleontology

Mary E. Martinez
Bureau of Land Management

Typist

Miguel M. Martinez
Bureau of Land Management

Socio-Economics, Land Use

Raul Martinez
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Jacqueline A. Morales
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Marlene Rael
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Mary Rockwell
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Rudy Romero
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Graphics

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Processing Consultant

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Bureau of Land Management

Hydrology, Engineering,
Geology, Geophysics,
Economics, and Mining

Secretary

Land Law Examiner

Chief, Environmental
& Planning Coordination
Staff

Appendix D-3

Order No. R-111-A

The current version of Order R-111-A, Potash-Oil Areas of Eddy and Lea County, New Mexico, with extensions, follows.

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

Appendix D-3

RECEIVED
BUREAU OF LAND MGMT.
IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
COMMISSION OF THE STATE OF NEW
MEXICO FOR THE PURPOSE OF
CONSIDERING:

STATE OFFICE
SANTA FE, NEW MEXICO

CASE NO. 278
Order No. R-111-A

THE APPLICATION OF THE OIL
CONSERVATION COMMISSION UPON
ITS OWN MOTION FOR AN ORDER
REVISING ORDER R-111 ISSUED IN
CASE 278, PREAMINING TO THE
POTASH-OIL AREAS OF EDDY AND
LEA COUNTIES, NEW MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 o'clock a. m. on July 14, 1955, August 17, 1955 and September 15, 1955, at Santa Fe, New Mexico, before the Oil Conservation Commission, hereinafter referred to as the "Commission".

NOW, on this 13th day of October, 1955, the Commission, a quorum being present, having considered the records and testimony adduced, and being fully advised in the premises;

FINDS:

(1) That due notice of the time and place of hearing and the purpose thereof having been given as required by law, the Commission has jurisdiction of this case and the subject matter thereof.

(2) That the delineation of an area including and containing potential oil and gas reserves, within which are commercial potash deposits, and the promulgation of rules and regulations for the orderly development of oil and gas resources in such area known to be productive of potash is within the authority of the Commission for the protection of correlative rights, the promotion of conservation, and the prevention of waste.

IT IS THEREFORE ORDERED:

That this order shall be known as The Rules and Regulations Governing the Exploration of Oil and Gas in Certain Areas Herein Defined, which are Known to contain Potash Reserves.

I.

OBJECTIVE

The objective of these Rules and Regulations is to prevent waste, protect correlative rights, assure maximum conservation of the oil, gas and potash

resources of New Mexico, and permit the economic recovery of oil, gas and potash minerals in the area hereinafter defined.

II.

THE POTASH-OIL AREA

(1) The Potash-Oil Area, as outlined in Exhibit A attached hereto and made a part hereof, represents the area in various part of which potash mining operations are now in progress, or in which core tests indicate commercial potash reserves.

(2) The Potash-Oil Area, as outlined herein, may be revised by the Commission after due notice and hearing.

III.

DRILLING IN THE POTASH AREA

(1) All drilling of oil and gas wells in the Potash Area shall be subject to these Rules and Regulations.

(2) No wells will be drilled for oil or gas at a location which, in the opinion of the Commission or its duly authorized representative, would result in undue waste of potash deposits or constitute a hazard to or interfere unduly with potash deposits.

No mining operations will be conducted in the Potash Area that would, in the opinion of the Commission or its duly authorized representative, constitute a hazard to oil or gas production, or that would unreasonably interfere with the orderly development and production from any oil or gas pool.

(3) Upon discovery of oil or gas in the Potash Area, the Oil Conservation Commission shall promulgate pool rules for the affected area after due notice and hearing.

IV.

DRILLING AND CASING PROGRAM

(1) For the purpose of the regulations and the drilling of oil and gas exploratory test wells, shallow and deep zones are defined, as follows:

(a) The shallow zone shall include all formations above the base of the Delaware sand or above a depth of 5,000 feet, whichever is the lesser.

(b) The deep zone shall include all formations below the base of the Delaware sand or below a depth of 5,000 feet, whichever is the lesser.

(2) Surface Casing Strings:

(a) A surface casing string of new or used oil field casing in good condition shall be set in the "Red Bed" section of the basal Rustler formation immediately above the salt section, or in the anhydrite at the top of the salt section, as determined necessary by the regulatory representative approving the drilling operations, and shall be cemented with not less than one hundred and fifty percent (150) percent of calculated volume necessary to circulate cement to the ground surface.

(b) Cement shall be allowed to stand a minimum of twelve (12) hours under pressure and a total of twenty-four (24) hours before drilling the plug or initiating tests.

(c) Casing and water-shut-off tests shall be made both before and after drilling the plug and below the casing seat as follows:

(1) If rotary tools are used, the mud shall be displaced with water and a hydraulic pressure of six hundred (600) pounds per square inch shall be applied. If a drop of one hundred (100) pounds per square inch or more should occur within thirty (30) minutes, corrective measures shall be applied.

(11) If cable tools are used, the mud shall be bailed from the hole, and if the hole does not remain dry for a period of one hour, corrective measures shall be applied.

(d) The above requirements for the surface casing string shall be applicable to both the shallow and deep zones.

(3) Salt Protection Strings:

(a) A salt protection string of new or used oil field casing in good condition shall be set not less than one hundred (100) feet nor more than six hundred (600) feet below the base of the salt section; provided that such string shall not be set below the top of the highest known oil or gas zone.

(b) The salt protection string shall be cemented, as follows:

(1) For wells drilled to the shallow zone, the string may be cemented with a nominal volume of cement for testing purposes only. If the exploratory test well is completed as a productive well, the string shall be re-cemented with sufficient cement to fill the annular space back of the pipe from the top of the first cementing to the surface or to the bottom of the cellar, or may be cut and pulled if the production string is cemented to the surface as provided in sub-section IV (5), (1) below.

(11) For wells drilled to the deep zone, the string must be cemented with sufficient cement to fill the annular space back of the pipe from the casing seat to the surface or to the bottom of the cellar; however, where the base of the Delaware Mountain Group is definable the casing rules in (IV) (3b) (1) shall apply even if the depth of the bottom of the Delaware Mountain Group is greater than 5,000 feet. For the purpose of identification, the base of the Delaware Mountain Group is hereby identified as the equivalent of the base of such formation as found at a depth of 7485 feet in the Richardson and Bass No. 1

-4-

Order No. R-111-A

Rodke well in Section 27, Township 20 South, Range 31 East, NMPM, Lea County, New Mexico, immediately overlying the Bone Springs formation.

(c) If the cement fails to reach the surface or the bottom of the cellar, where required, the top of the cement shall be located by a temperature or gamma ray survey and additional cementing shall be done until the cement is brought to the point required.

(d) The fluid used to mix with the cement shall be saturated with the salts common to the zones penetrated and with suitable proportions but not less than 1% of calcium chloride by weight of cement.

(e) Cement shall be allowed to stand a minimum of twelve (12) hours under pressure and a total of twenty-four (24) hours before drilling the plug or initiating tests.

(f) Casing tests shall be made both before and after drilling the plug and below the casing seat, as follows:

(i) If rotary tools are used, the mud shall be displaced with water and a hydraulic pressure of one thousand (1000) pounds per square inch shall be applied. If a drop of one hundred (100) pounds per square inch or more should occur within thirty (30) minutes, corrective measures shall be applied.

(ii) If cable tools are used, the mud shall be bailed from the hole and if the hole does not remain dry for a period of one hour, corrective measures shall be applied.

(g) The Commission, or its duly authorized representative, may require the use of centralizers on the salt protection string when in their judgment the use of such centralizers would offer further protection to the salt section.

(h) The above requirements for the salt protection string shall be applicable to both the shallow and deep zones except for sub-section IV (3), (b), (1) and (ii) above.

(4) Intermediate String:

(a) In the drilling of oil and gas exploratory test wells to the deep zone, the operator shall have the option of running an intermediate string of pipe, unless the Commission requires an intermediate string.

(b) Cementing procedures and casing tests for the intermediate string shall be the same as provided under sub-sections IV (3), (c), (e) and (f) for the salt protection string.

(5) Production String:

(a) A production string shall be set on top or through the oil or gas pay zone and shall be cemented as follows:

(1) For wells drilled to the shallow zone the

production string shall be cemented to the surface if the salt protection string was cemented only with a nominal volume for testing purposes, in which case the salt protection string can be cut and pulled before the production string is cemented; provided, that if the salt protection string was cemented to the surface, the production string shall be cemented with a volume adequate to protect the pay zone and the casing above such zone.

(ii) For wells drilled to the deep zone, the production string shall be cemented with a volume adequate to protect the pay zone and the casing above such zone; provided, that if no intermediate string shall have been run and cemented to the surface, the production string shall be cemented to the surface.

(b) Cementing procedures and casing tests for the production string shall be the same as provided under sub-section IV (3), (c) (e) and (f) for the salt protection string; however if high pressure oil or gas production is discovered in an area, the Commission shall promulgate the necessary rules to prevent the charging of the salt section.

V.

DRILLING FLUID FOR SALT SECTION

The fluid used while drilling the salt section shall consist of water, to which has been added sufficient salts of a character common to the zone penetrated to completely saturate the mixture. Other admixtures may be added to the fluid by the operator in overcoming any specific problem. This requirement is specifically intended to prevent enlarged drill holes.

VI.

PLUGGING AND ABANDONMENT OF WELLS

(1) All wells heretofore and hereafter drilled within the Potash Area shall be plugged in a manner and in accordance with field rules established by the Commission that will provide a solid cement plug through the salt section and any water bearing horizon and prevent liquids or gases from entering the hole above or below the salt section.

(2) The fluid used to mix the cement shall be saturated with the salts common to the salt section penetrated and with suitable proportions but not more than three (3) percent of calcium chloride by weight of cement being considered the desired mixture whenever possible.

VII.

LOCATION FOR WELLS

Before commencing drilling operations for oil or gas on any lands within the Potash Area, the well operator shall prepare a map or plat showing the location of

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the proposed well, said map or plat to accompany each copy of the Notice of Intention to Drill. In addition to the number of copies required by the Commission, the well operator shall send one copy by registered mail to all potash operators holding potash leases within a radius of one mile of the proposed well, as reflected by the plats submitted under paragraph IX (2).

The well operator shall furnish proof of the fact that said potash operators were notified by registered mail of his intent by attaching return receipt to the copies of the Notice of Intention to Drill and plats furnished the Commission.

The Commission, or its authorized representative, may approve such Notice of Intention to Drill if no objection to the location of the proposed well is made by a potash operator within ten days after receipt. If the location of the proposed well is objected to by the potash operator, the matter shall be referred to the Secretary-Director of the Commission for arbitration. If a satisfactory settlement cannot be reached, the Secretary-Director of the Commission shall refer the matter to a hearing before the Commission after due notice and a decision either approving or denying the operator's plans to drill shall be entered by the Commission.

VIII.

INSPECTION OF DRILLING AND MINING OPERATIONS

A representative of the potash operator may be present during drilling, cementing, casing, and plugging of all oil or gas wells within a radius of one mile of the well location to observe conformance with these regulations. Likewise, a representative of the oil and gas lessee may inspect mine workings on his lease to observe conformance with these regulations.

IX.

FILING OF WELL SURVEYS, MINE SURVEYS AND POTASH DEVELOPMENT PLANS

(1) Directional Surveys:

The Commission may require an operator to file a certified directional survey from the surface to a point below the lowest known potash bearing horizon on all wells drilled within the Potash Area. These surveys may be required where, in the Commission's judgment, the exact location of the well-bore must be determined in order to aid mining operations.

(2) Mine Surveys:

Within 30 days after the adoption of this order, and thereafter on or before January 31st of each year, each potash operator shall furnish two copies of a plat of a survey of the location of his leaseholdings and all of his open mine workings, which plat shall be available for public inspection.

(3) Potash Development Plans:

Within 30 days after adoption of this order and thereafter on or before January 31st of each year, each potash operator shall furnish two copies of a projection of development plans in the form of a plat, which plat shall be for the confidential use of the Commission and for inspection by any affected oil or gas operator. The projection shall cover not less than 3 nor more than a 5 year development program.

X.

APPLICABILITY OF STATEWIDE RULES AND REGULATIONS

All general statewide rules and regulations of the Oil Conservation Commission governing the development, operation, and production of oil and gas in the State of New Mexico not inconsistent or in conflict herewith, are hereby adopted and made applicable to the areas described herein.

EXHIBIT "A"POTASH-OIL AREATOWNSHIP 18 SOUTH, RANGE 30 EAST

Section 13: SW/4
 Section 14: S/2, NW/4, W/2 NE/4
 Section 15: SE/4
 Section 22: E/2, E/2 W/2
 Section 23: All
 Section 24: NW/4
 Section 26: N/2
 Section 27: N/2 NE/4

TOWNSHIP 19 SOUTH, RANGE 29 EAST

Section 11: SW/4
 Section 12: S/2, S/2 NE/4
 Section 13: N/2, N/2 S/2, S/2 SW/4
 Section 14: E/2, E/2 W/2
 Section 23: N/2 NE/4

TOWNSHIP 19 SOUTH, RANGE 30 EAST

Section 3: S/2
 Section 4: S/2, NW/4, SW/4 NE/4
 Section 5: E/2, E/2 W/2, SW/4 SW/4
 Section 7: S/2, S/2 N/2, N/2 NE/4
 Section 8: All
 Section 9: All
 Section 10: All
 Section 11: SW/4, W/2 SE/4
 Section 14: W/2, W/2 SE/4
 Section 15: All
 Section 16: All
 Section 17: All
 Section 18: E/2, NW/4
 Section 19: NE/4
 Section 20: N/2, SE/4 SE/4
 Section 21: All
 Section 22: All
 Section 23: W/2
 Section 26: W/2, SE/4
 Section 27: All
 Section 28: All
 Section 29: E/2
 Section 32: SE/4, NE/4 NE/4
 Section 33: All
 Section 34: All
 Section 35: All
 Section 36: SW/4, S/2 NW/4, S/2 SE/4

TOWNSHIP 19 SOUTH, RANGE 31 EAST
 Section 36: SE/4

TOWNSHIP 19 SOUTH, RANGE 32 EAST
 Section 31: W/2 SW/4
 Section 33: SE/4, E/2 SW/4
 Section 34: S/2
 Section 35: S/2
 Section 36: SW/4, SE/4 SE/4

TOWNSHIP 19 SOUTH, RANGE 33 EAST
 Section 22: SE/4 SE/4
 Section 23: SW/4
 Section 25: SW/4
 Section 26: All
 Section 27: E/2
 Section 31: S/2
 Section 32: SW/4
 Section 34: NE/4 NE/4
 Section 35: All
 Section 36: S/2, NW/4 W/2 NE/4

TOWNSHIP 19 SOUTH, RANGE 34 EAST
 Section 31: SW/4 SW/4

TOWNSHIP 20 SOUTH, RANGE 29 EAST
 Section 13: SW/4 SW/4
 Section 14: SE/4 SE/4
 Section 22: SE/4, C/2 NE/4
 Section 23: S/2, NE/4
 Section 24: W/2, W/2 SE/4
 Section 25: N/2, N/2 S/2
 Section 26: All
 Section 27: E/2
 Section 34: NE/4, N/2 SE/4
 Section 35: NW/4

TOWNSHIP 20 SOUTH, RANGE 30 EAST

Section 1: All
 Section 2: All
 Section 3: All
 Section 4: All
 Section 5: S/2, NE/4
 Section 6: S/2, S/2 NE/4
 Section 7: NW/4, E/2
 Section 8: All
 Section 9: All
 Section 10: All
 Section 11: All
 Section 12: All
 Section 13: All
 Section 14: All
 Section 15: All
 Section 16: All
 Section 17: All
 Section 18: E/2
 Section 19: E/2

EXHIBIT "A" (Continued)

TOWNSHIP 20 SOUTH, RANGE 30 EAST (continued)

Section 20: All
Section 21: All
Section 22: All
Section 23: All
Section 24: All
Section 25: All
Section 26: All
Section 27: All
Section 28: All
Section 29: All
Section 30: All
Section 31: E/2
Section 32: All
Section 33: All
Section 34: All
Section 35: All
Section 36: All

TOWNSHIP 20 SOUTH, RANGE 31 EAST

Section 1: E/2, E/2 W/2
Section 6: SW/4, S/2 NW/4, W/2 SE/4
Section 7: W/2, SE/4, W/2 NE/4
Section 8: S/2, S/2 N/2
Section 9: SW/4, S/2 NW/4
Section 11: SE/4, E/2 SW/4
Section 12: All
Section 13: All
Section 14: E/2, SW/4, E/2 NW/4
Section 16: W/2
Section 17: All
Section 18: All
Section 19: All
Section 20: All
Section 21: NW/4, S/2
Section 22: S/2, S/2 NE/4
Section 23: All
Section 24: All
Section 25: All
Section 26: All
Section 27: All
Section 28: All
Section 29: All
Section 30: All
Section 31: All
Section 32: All
Section 33: All
Section 34: All
Section 35: All
Section 36: All

TOWNSHIP 20 SOUTH, RANGE 32 EAST

Section 1: All
Section 2: All
Section 3: All
Section 4: E/2, SW/4, E/2 NW/4

EXHIBIT "A" (continued)

TOWNSHIP 20 SOUTH, RANGE 32 EAST, (continued)

Section 5: S/2 SE/4
Section 6: W/2, SW/4 SE/4
Section 7: All
Section 8: All
Section 9: All
Section 10: All
Section 11: All
Section 12: All
Section 13: All
Section 14: All
Section 15: All
Section 16: All
Section 17: All
Section 18: All
Section 19: All
Section 20: All
Section 21: All
Section 22: All
Section 23: All
Section 24: All
Section 25: All
Section 26: All
Section 27: All
Section 28: All
Section 29: All
Section 30: All
Section 31: All
Section 32: All
Section 33: All
Section 34: All
Section 35: All
Section 36: All

TOWNSHIP 20 SOUTH, RANGE 33 EAST

Section 1: All
Section 2: E/2, E/2 W/2
Section 5: W/2
Section 6: All
Section 7: All
Section 8: W/2, SW/4 NE/4, SE/4
Section 9: S/2 S/2, NW/4 SW/4
Section 10: S/2
Section 11: E/2, E/2 NW/4, SW/4
Section 12: All
Section 13: All
Section 14: All
Section 15: All
Section 16: All
Section 17: All
Section 18: All
Section 19: All
Section 20: All
Section 21: W/2 SW/4, NW/4, N/2 NE/4

EXHIBIT 9A (Continued)

TOWNSHIP 20 SOUTH, RANGE 33 EAST, (Continued)

Section 22: N/2 N/2
Section 23: N/2 N/2, SE/4 NE/4
Section 24: N/2, N/2 SE/4, SE/4 SE/4
Section 29: W/2, NE/4, N/2 SE/4, SW/4 SE/4
Section 30: All
Section 31: N/2, W/2 SW/4

TOWNSHIP 20 SOUTH, RANGE 34 EAST

Section 6: W/2, W/2 SE/4
Section 7: All
Section 8: SW/4
Section 16: SW/4, SW/4 NW/4, SW/4 SE/4
Section 17: All
Section 18: All
Section 19: All
Section 20: All
Section 21: All
Section 22: SW/4
Section 27: W/2
Section 28: All
Section 29: N/2, SE/4, NE/4 SW/4
Section 30: NE/4 NW/4, N/2 NE/4, SE/4 NE/4
Section 32: N/2 NE/4, SE/4 NE/4
Section 33: N/2, SE/4, N/2 SW/4, SE/4 SW/4
Section 34: W/2

TOWNSHIP 21 SOUTH, RANGE 29 EAST

Section 1: All
Section 2: Lots 1 - 16, incl., SE/4, NE/4 SW/4
Section 3: Lots 1 - 9, incl.
Section 4: Lots 1 - 8, incl., Lots 10 and 11
Section 11: E/2, E/2 SW/4
Section 12: All
Section 13: All
Section 14: E/2, E/2 W/2, SW/4 NW/4, NW/4 SW/4
Section 15: SE/4 NE/4, NE/4 SE/4
Section 23: N/2 NE/4
Section 24: NE/4, NE/4 SE/4, N/2 NW/4, SE/4 NW/4
Section 35: S/2 NE/4, SE/4, E/2 SW/4
Section 36: S/2 SW/4, SE/4, S/2 NE/4, NE/4 NE/4

TOWNSHIP 21 SOUTH, RANGE 30 EAST

Section 1: All
Section 2: All
Section 3: All
Section 4: All
Section 5: All
Section 6: All
Section 7: All
Section 8: All
Section 9: N/2, SW/4
Section 10: N/2, SE/4, N/2 SW/4, SE/4 SW/4
Section 11: All
Section 12: All
Section 13: All

EXHIBIT "A" (continued)

TOWNSHIP 21 SOUTH, RANGE 30 EAST (continued)

Section 14: All
Section 15: NE/4, NE/4 NW/4, N/2 SE/4, SE/4 SE/4
Section 16: NW/4 NW/4
Section 17: All
Section 18: All
Section 19: All
Section 20: NW/4, N/2 NE/4
Section 22: E/2 E/2
Section 23: All
Section 24: All
Section 25: N/2, SE/4, N/2 SW/4, SE/4 SW/4
Section 26: N/2, N/2 S/2
Section 27: NE/4, N/2 SE/4, SE/4 SE/4
Section 29: NW/4, N/2 SW/4
Section 30: E/2, E/2 W/2
Section 31: All
Section 32: S/2, NW/4, NW/4 NE/4, S/2 NE/4
Section 36: E/2

TOWNSHIP 21 SOUTH, RANGE 31 EAST

Section 1: All
Section 2: All
Section 3: All
Section 4: All
Section 5: All
Section 6: All
Section 7: All
Section 8: All
Section 9: All
Section 10: W/2
Section 12: N/2, SE/4, N/2 SW/4, SE/4 SW/4
Section 13: N/2 NE/4
Section 15: W/2
Section 16: E/2, NW/4, E/2 SW/4
Section 18: NW/4, W/2 NE/4, NE/4 NE/4, W/2 SW/4
NE/4 SW/4
Section 21: E/2, NE/4 NW/4
Section 22: W/2
Section 27: W/2, SW/4 NE/4, W/2 SE/4
Section 28: E/2
Section 30: SW/4, W/2 NW/4, SE/4 NW/4
Section 31: W/2
Section 33: NE/4 NE/4
Section 34: NW/4, NW/4 NE/4

TOWNSHIP 21 SOUTH, RANGE 32 EAST

Section 6: Lots 1 - 7 incls., Lots 10 - 15, inclus., SW/4
Section 7: W/2
Section 22: E/2
Section 23: All
Section 24: All

EXHIBIT "A" (continued)

TOWNSHIP 21 SOUTH, RANGE 33 EAST

Section 3: Lots 1, 2, 3
Section 17: S/2 S/2
Section 18: SE/4 SE/4
Section 19: All
Section 20: All
Section 21: W/2, SE/4, S/2 NE/4
Section 22: S/2, S/2 N/2
Section 23: S/2, S/2 N/2, NE/4 NE/4
Section 24: All
Section 25: NW/4, N/2 NE/4, SW/4 NE/4, N/2 SW/4
Section 26: W/2, NE/4, N/2 SE/4, SW/4 SE/4
Section 27: All
Section 28: All
Section 29: N/2, SE/4, NE/4 SW/4
Section 30: N/2 NE/4, SE/4 NE/4
Section 33: N/2 N/2
Section 34: N/2 N/2

TOWNSHIP 21 SOUTH, RANGE 34 EAST

Section 19: W/2

TOWNSHIP 22 SOUTH, RANGE 29 EAST

Section 1: All
Section 2: E/2, E/2 NW/4, SW/4
Section 3: S/2 SE/4, NE/4 SE/4
Section 10: E/2, E/2 W/2, SW/4 SW/4
Section 11: All
Section 12: All
Section 13: All
Section 14: All
Section 15: All
Section 16: SE/4, SE/4 NE/4, SE/4 SW/4
Section 20: E/2 E/2
Section 21: All
Section 22: All
Section 23: All
Section 24: All
Section 25: All
Section 26: All
Section 27: All
Section 28: NE/4, N/2 NW/4, SE/4 NW/4, SE/4
Section 33: NE/4 NE/4
Section 34: NW/4, W/2 E/2, N/2 SW/4, SE/4 SW/4
Section 35: E/2, SW/4, SE/4 NW/4
Section 36: All

TOWNSHIP 22 SOUTH, RANGE 30 EAST

Section 1: E/2
Section 5: N/2, N/2 S/2, SW/4 SW/4
Section 6: All
Section 7: W/2, W/2 E/2, SE/4 SE/4
Section 8: S/2 SW/4
Section 12: NE/4 NE/4
Section 13: NW/4, N/2 SW/4, SW/4 SW/4
Section 14: SE/4, S/2 NE/4, E/2 SW/4, SW/4 SW/4
Section 17: NW/4
Section 18: All
Section 19: All

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EXHIBIT "A" (continued)

TOWNSHIP 22 SOUTH, RANGE 30 EAST (continued)

Section 20: All
 Section 21: S/2, SW/4 NW/4
 Section 22: S/2, S/2 N/2, NE/4 NE/4
 Section 23: W/2, W/2 NE/4, NE/4 NE/4
 Section 26: W/2 W/2
 Section 27: All
 Section 28: All
 Section 29: All
 Section 30: All
 Section 31: All
 Section 32: All
 Section 33: All
 Section 34: All
 Section 35: W/2

TOWNSHIP 22 SOUTH, RANGE 31 EAST

Section 6: W/2, W/2 NE/4, NW/4 SE/4
 Section 7: N/2 NW/4

TOWNSHIP 23 SOUTH, RANGE 29 EAST

Section 1: All
 Section 2: E/2, NW/4, NE/4 SW/4
 Section 11: NE/4 NE/4
 Section 12: N/2 N/2

TOWNSHIP 23 SOUTH, RANGE 30 EAST

Section 2: NW/4
 Section 3: All
 Section 4: All
 Section 5: All
 Section 6: All
 Section 7: NE/4, N/2 NW/4, SE/4 NW/4
 Section 8: N/2 N/2, S/2 NE/4
 Section 9: N/2, NE/4 SW/4, N/2 SE/4
 Section 10: N/2, SW/4

DONE at Santa Fe, New Mexico on the day and year hereinabove designated.

STATE OF NEW MEXICO
 OIL CONSERVATION COMMISSION

JOHN F. SIMMS, Chairman

E. S. WALKER, Member

W. B. MACEY, Member & Secretary

SEAL

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NEW MEXICO OIL CONSERVATION COMMISSION
SANTA FE - NEW MEXICO

EXTENSIONS AS CONTAINED IN ORDERS R-111-B
THROUGH R-111-J, INCLUSIVE, TO THE POTASH-
OIL AREA AS DEFINED BY ORDER NO. R-111-A

TOWNSHIP 18 SOUTH, RANGE 30 EAST

Section 22: W/2 W/2
Section 27: NE/4 NW/4

TOWNSHIP 19 SOUTH, RANGE 29 EAST

Section 13: S/2 SE/4
Section 14: W/2 SW/4
Section 23: N/2 NW/4, SE/4 NW/4, S/2 NE/4
Section 24: NW/4, W/2 NE/4, NE/4 NE/4

TOWNSHIP 19 SOUTH, RANGE 30 EAST

Section 14: W/2 NE/4
Section 18: SW/4

TOWNSHIP 19 SOUTH, RANGE 31 EAST

Section 36: N/2 & SW/4

TOWNSHIP 19 SOUTH, RANGE 32 EAST

Section 33: N/2 & W/2 SW/4
Section 34: N/2

TOWNSHIP 20 SOUTH, RANGE 29 EAST

Section 13: SW/4 NW/4 & NW/4 SW/4
Section 14: SE/4 NW/4, S/2 NE/4, SW/4,
NE/4 SE/4 & W/2 SE/4
Section 15: SE/4 SE/4
Section 22: NE/4 NE/4
Section 23: NW/4
Section 25: S/2 S/2

TOWNSHIP 20 SOUTH, RANGE 31 EAST

Section 1: W/2 W/2
Sections 2 & 3: All
Section 11: N/2 & W/2 SW/4
Section 14: W/2 NW/4

TOWNSHIP 20 SOUTH, RANGE 32 EAST

Section 4: W/2 NW/4
Section 5: N/2, SW/4, & N/2 SE/4
Section 6: NE/4, N/2 SE/4, & SE/4 SE/4

TOWNSHIP 21 SOUTH, RANGE 29 EAST

Section 2: S/2 SW/4 & NW/4 SW/4
Section 10: E/2 SE/4
Section 11: NW/4 & W/2 SW/4
Section 14: NW/4 NW/4
Section 15: NE/4 NE/4

TOWNSHIP 21 SOUTH, RANGE 31 EAST

Section 10: E/2
Section 11: All
Section 12: SW/4 SW/4
Section 13: W/2
Section 14: All
Section 15: E/2
Section 16: W/2 SW/4
Section 17: All
Section 18: SE/4 NE/4, SE/4 &
SE/4 SW/4
Sections 19 & 20 All
Section 21: NW/4 NW/4, & S/2 NW/4,
& SW/4
Section 22: E/2
Section 23: N/2
Section 24: NW/4
Section 27: E/2 E/2 & NW/4 NE/4
Section 34: E/2 NE/4 & SW/4 NE/4

TOWNSHIP 22 SOUTH, RANGE 29 EAST

Section 31: SE/4
Section 32: NE/4 and S/2
Section 33: W/2, NW/4 NE/4, S/2 NE/4, &
SE/4
Section 34: SW/4 SW/4 & E/2 E/2
Section 35: N/2 NW/4 and SW/4 NW/4

TOWNSHIP 22 SOUTH, RANGE 30 EAST

Section 4: W/2 W/2
Section 5: S/2 SE/4 & SE/4 SW/4
Section 7: E/2 NE/4 & NE/4 SE/4
Section 8: N/2 & N/2 SW/4
Section 9: W/2 NW/4
Section 23: SE/4 & SE/4 NE/4
Section 24: W/2 W/2
Section 25: W/2 W/2
Section 26: E/2 W/2 & E/2
Section 35: E/2

TOWNSHIP 23 SOUTH, RANGE 29 EAST

Section 2: W/2 SW/4 and SE/4 SW/4
Sections 3, 4, and 5: All
Section 6: E/2
Section 7: N/2 NE/4

TOWNSHIP 21 SOUTH, RANGE 29 EAST

Section 2: S/2 SW/4 & NW/4 SW/4
Section 10: E/2 SE/4
Section 11: NW/4 & W/2 SW/4
Section 14: NW/4 NW/4
Section 15: NE/4 NE/4

TOWNSHIP 21 SOUTH, RANGE 31 EAST

Section 10: E/2
Section 11: All
Section 12: SW/4 SW/4
Section 13: W/2
Section 14: All
Section 15: E/2
Section 16: W/2 SW/4
Section 17: All
Section 18: SE/4 NE/4, SE/4 &
SE/4 SW/4
Sections 19 & 20 All
Section 21: NW/4 NW/4, & S/2 NW/4,
& SW/4
Section 22: E/2
Section 23: N/2
Section 24: NW/4
Section 27: E/2 E/2 & NW/4 NE/4
Section 34: E/2 NE/4 & SW/4 NE/4

TOWNSHIP 22 SOUTH, RANGE 29 EAST

Section 31: SE/4
Section 32: NE/4 and S/2
Section 33: W/2, NW/4 NE/4, S/2 NE/4, &
SE/4
Section 34: SW/4 SW/4 & E/2 E/2
Section 35: N/2 NW/4 and SW/4 NW/4

TOWNSHIP 22 SOUTH, RANGE 30 EAST

Section 4: W/2 W/2
Section 5: S/2 SE/4 & SE/4 SW/4
Section 7: E/2 NE/4 & NE/4 SE/4
Section 8: N/2 & N/2 SW/4
Section 9: W/2 NW/4
Section 23: SE/4 & SE/4 NE/4
Section 24: W/2 W/2
Section 25: W/2 W/2
Section 26: E/2 W/2 & E/2
Section 35: E/2

TOWNSHIP 23 SOUTH, RANGE 29 EAST

Section 2: W/2 SW/4 and SE/4 SW/4
Sections 3, 4, and 5: All
Section 6: E/2
Section 7: N/2 NE/4

TOWNSHIP 23 SOUTH, RANGE 29 EAST con'd

Section 8: N/2 N/2 & SE/4 NE/4
Section 9: NW/4 & N/2 NE/4
Section 10: All
Section 11: NW/4, N/2 SW/4, W/2 NE/4, SE/4 NE/4,
& SE/4
Section 12: S/2 N/2 and S/2
Section 13: E/2 E/2
Section 15: W/2, W/2 E/2, & NE/4 NE/4
Section 21: SE/4
Section 22: W/2, W/2 NE/4, SE/4 NE/4,
& SE/4

Section 23: S/2
Section 24: E/2 NE/4
Section 26: All
Section 27: N/2 & E/2 SE/4
Section 34: E/2 NE/4 & NE/4 SE/4
Section 35: NW/4, N/2 SW/4, W/2 NE/4,
SE/4 NE/4, & NW/4 SE/4
Section 36: S/2 NW/4, SW/4 NE/4, N/2 SW/4,
& NW/4 SE/4

TOWNSHIP 23 SOUTH, RANGE 30 EAST

Section 2: S/2 & NE/4
Section 7: SW/4 NW/4 & S/2
Section 8: S/2 & S/2 NW/4
Section 9: S/2 SW/4, NW/4 SW/4,
& S/2 SE/4
Section 10: SE/4
Sections 11 through 15: All
Sections 16, 17, and 18: All
Section 19: N/2, NE/4 SW/4, & N/2 SE/4
Section 20: SE/4 SE/4
Section 21: SW/4 SW/4
Sections 24 and 25: All
Section 26: E/2
Section 28: W/2 W/2
Section 29: E/2 E/2
Section 32: NE/4 NE/4
Section 33: NW/4 NW/4

TOWNSHIP 23 SOUTH, RANGE 31 EAST

Section 7: S/2, NW/4, S/2 NE/4, & NW/4 NE/4
Section 18: All
Sections 19 and 20: All
Sections 27 through 30: All

March 25, 1975

dr/



United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

FEB 20 1976

Memorandum

To: State Director, Bureau of Land Management,
Santa Fe, New Mexico

From: Chief, Conservation Division

Subject: Revision of the Carlsbad Known Potash Leasing Area,
New Mexico

Effective April 17, 1975, the Carlsbad known potash leasing area has been revised to contain 69,710 additional acres, as subject to the competitive potash leasing provisions of the Mineral Leasing Act of 1920, as amended (30 U.S.C. 283).

A diagram showing the boundaries of the revised known leasing area and a description of the contained lands are enclosed for your use. Queries with respect to the revised known leasing area should be addressed to the Regional Conservation Manager, Central Region, Denver, Colorado 80225, or to the Area Geologist, Southern Rocky Mountain Area, Roswell, New Mexico 88201.

Paul H. Wauson

Chief, Conservation Division

Enclosures

Date Routed FEB 26 1976

1 SD *File* Info. *v*

1 ASD *File*

3 IC Action

4 *File*

2 *File* (Term)

1 AD

1 AG

1 NS

5 CF

Other



CARLSBAD KNOWN POTASH LEASING AREA, NEW MEXICO

Land Description
to accompany diagram of
effective April 17, 1975

New Mexico Principal Meridian, New Mexico

- T. 19 S., R. 29 E.,
sec. 24, SW $\frac{1}{4}$ NE $\frac{1}{4}$, S $\frac{1}{2}$ NW $\frac{1}{4}$, N $\frac{1}{2}$ SW $\frac{1}{4}$.
- T. 19 S., R. 30 E.,
sec. 2, E $\frac{1}{2}$ SW $\frac{1}{4}$;
sec. 5, lot 3;
sec. 11, S $\frac{1}{2}$ NE $\frac{1}{4}$, NW $\frac{1}{4}$ NW $\frac{1}{4}$;
sec. 12, SW $\frac{1}{4}$ NE $\frac{1}{4}$, S $\frac{1}{2}$ NW $\frac{1}{4}$, W $\frac{1}{2}$ SE $\frac{1}{4}$;
sec. 18, lot 4, SE $\frac{1}{4}$ SW $\frac{1}{4}$;
sec. 24, E $\frac{1}{2}$ NW $\frac{1}{4}$, SW $\frac{1}{4}$ NW $\frac{1}{4}$, NW $\frac{1}{4}$ SW $\frac{1}{4}$, SE $\frac{1}{4}$ SW $\frac{1}{4}$;
sec. 29, NW $\frac{1}{4}$ NW $\frac{1}{4}$;
sec. 32, SE $\frac{1}{4}$ SW $\frac{1}{4}$.
- T. 19 S., R. 31 E.,
sec. 34, SE $\frac{1}{4}$ SE $\frac{1}{4}$;
sec. 35, S $\frac{1}{2}$ SW $\frac{1}{4}$, SW $\frac{1}{4}$ SE $\frac{1}{4}$.
- T. 19 S., R. 32 E.,
sec. 33, lot 1, NW $\frac{1}{4}$ SW $\frac{1}{4}$;
sec. 36, NE $\frac{1}{4}$ SE $\frac{1}{4}$.
- T. 19 S., R. 33 E.,
sec. 22, SE $\frac{1}{4}$ NE $\frac{1}{4}$, E $\frac{1}{2}$ SW $\frac{1}{4}$, W $\frac{1}{2}$ SE $\frac{1}{4}$, NE $\frac{1}{4}$ SE $\frac{1}{4}$;
sec. 23, S $\frac{1}{2}$ NW $\frac{1}{4}$, N $\frac{1}{2}$ SW $\frac{1}{4}$, W $\frac{1}{2}$ SE $\frac{1}{4}$, SE $\frac{1}{4}$ SE $\frac{1}{4}$;
sec. 25, SW $\frac{1}{4}$ NW $\frac{1}{4}$;
sec. 26, NE $\frac{1}{4}$ NE $\frac{1}{4}$;
sec. 27, NW $\frac{1}{4}$, N $\frac{1}{2}$ SW $\frac{1}{4}$, SW $\frac{1}{4}$ SW $\frac{1}{4}$;
sec. 28, S $\frac{1}{2}$ SE $\frac{1}{4}$, NE $\frac{1}{4}$ SE $\frac{1}{4}$;
sec. 31, S $\frac{1}{2}$ NE $\frac{1}{4}$;
sec. 32, NE $\frac{1}{4}$, S $\frac{1}{2}$ NW $\frac{1}{4}$;
sec. 33, N $\frac{1}{2}$ NE $\frac{1}{4}$, SW $\frac{1}{4}$ NE $\frac{1}{4}$, W $\frac{1}{2}$, W $\frac{1}{2}$ SE $\frac{1}{4}$.
- T. 20 S., R. 29 E.,
sec. 14, NW $\frac{1}{4}$ NE $\frac{1}{4}$, N $\frac{1}{2}$ NW $\frac{1}{4}$, SW $\frac{1}{4}$ NW $\frac{1}{4}$;
sec. 15, E $\frac{1}{2}$ NE $\frac{1}{4}$;
sec. 22, NW $\frac{1}{4}$ NE $\frac{1}{4}$.
- T. 20 S., R. 30 E.,
sec. 5, lot 3, SW $\frac{1}{4}$ NE $\frac{1}{4}$, SE $\frac{1}{4}$ NW $\frac{1}{4}$;
sec. 19, SW $\frac{1}{4}$ SE $\frac{1}{4}$.
- T. 20 S., R. 31 E.,
sec. 1, SW $\frac{1}{4}$ NW $\frac{1}{4}$, W $\frac{1}{2}$ SW $\frac{1}{4}$;
sec. 2;
sec. 3, lots 1 and 2, S $\frac{1}{2}$ NE $\frac{1}{4}$, SE $\frac{1}{4}$;
sec. 9, SE $\frac{1}{4}$ SE $\frac{1}{4}$;

T. 20 S., R. 31 E., (continued)

- sec. 10, $E\frac{1}{2}$, $SW\frac{1}{4}$;
- sec. 11, $N\frac{1}{2}NE\frac{1}{4}$, $NW\frac{1}{4}$, $W\frac{1}{2}SW\frac{1}{4}$.

T. 20 S., R. 32 E.,

- sec. 4, lot 4, $SW\frac{1}{4}NW\frac{1}{4}$.

T. 20 S., R. 33 E.,

- sec. 4;
- sec. 5, $S\frac{1}{2}NE\frac{1}{4}$, $SE\frac{1}{4}$;
- sec. 8, $NE\frac{1}{4}NE\frac{1}{4}$;
- sec. 9, $N\frac{1}{2}$;
- sec. 22, $S\frac{1}{2}NE\frac{1}{4}$, $SE\frac{1}{4}NW\frac{1}{4}$, $E\frac{1}{2}SW\frac{1}{4}$, $SE\frac{1}{4}$;
- sec. 23, $SW\frac{1}{4}NW\frac{1}{4}$, $S\frac{1}{2}$;
- sec. 24, $W\frac{1}{2}SW\frac{1}{4}$, $SE\frac{1}{4}SW\frac{1}{4}$, $SW\frac{1}{4}SE\frac{1}{4}$;
- secs. 25 and 26;
- sec. 27, $E\frac{1}{2}$, $E\frac{1}{2}W\frac{1}{2}$, $SW\frac{1}{4}NW\frac{1}{4}$, $W\frac{1}{2}SW\frac{1}{4}$;
- sec. 28, $SW\frac{1}{4}NE\frac{1}{4}$, $SE\frac{1}{4}NW\frac{1}{4}$, $S\frac{1}{2}$;
- sec. 29, $SE\frac{1}{4}SE\frac{1}{4}$;
- sec. 31, $SE\frac{1}{4}$;
- sec. 32, $E\frac{1}{2}$, $E\frac{1}{2}W\frac{1}{2}$, $SW\frac{1}{4}NW\frac{1}{4}$, $W\frac{1}{2}SW\frac{1}{4}$;
- secs. 33 to 36, inclusive.

T. 20 S., R. 34 E.,

- sec. 26, $SW\frac{1}{4}SW\frac{1}{4}$;
- sec. 27, $E\frac{1}{2}SE\frac{1}{4}$;
- sec. 30, lots 1 to 4 inclusive, $SW\frac{1}{4}NE\frac{1}{4}$, $SE\frac{1}{4}NW\frac{1}{4}$, $E\frac{1}{2}SW\frac{1}{4}$, $SE\frac{1}{4}$;
- sec. 31;
- sec. 34, $E\frac{1}{2}E\frac{1}{2}$;
- sec. 35, $SW\frac{1}{4}NE\frac{1}{4}$, $W\frac{1}{2}$, $SE\frac{1}{4}$.

T. 21 S., R. 29 E.,

- sec. 4, lot 13, $NE\frac{1}{4}SW\frac{1}{4}$, $W\frac{1}{2}SE\frac{1}{4}$, $SE\frac{1}{4}SE\frac{1}{4}$.

T. 21 S., R. 31 E.,

- sec. 13, $SE\frac{1}{4}NE\frac{1}{4}$, $SE\frac{1}{4}$;
- sec. 23, $S\frac{1}{2}S\frac{1}{2}$;
- sec. 24, $E\frac{1}{2}$, $S\frac{1}{2}SW\frac{1}{4}$;
- secs. 25 and 26;
- sec. 28, $W\frac{1}{2}$, $SW\frac{1}{4}SE\frac{1}{4}$;
- sec. 29, $E\frac{1}{2}NE\frac{1}{4}$, $SW\frac{1}{4}NE\frac{1}{4}$, $S\frac{1}{2}$;
- sec. 30, $E\frac{1}{2}SE\frac{1}{2}$;
- sec. 31, $E\frac{1}{2}E\frac{1}{2}$;
- sec. 32;
- sec. 33, $SE\frac{1}{4}NE\frac{1}{4}$, $W\frac{1}{2}NE\frac{1}{4}$, $W\frac{1}{2}$, $SE\frac{1}{4}$;
- sec. 34, $S\frac{1}{2}$;
- secs. 35 and 36.

T. 21 S., R. 32 E.,

- secs. 1 to 4 inclusive;
- sec. 5, lots 1, 2, 3, 5 to 16 inclusive, $S\frac{1}{2}$;
- sec. 6, lots 9, 15, 16, $SE\frac{1}{4}SW\frac{1}{4}$, $SE\frac{1}{4}$;
- sec. 7, $E\frac{1}{2}$, $E\frac{1}{2}W\frac{1}{2}$;
- secs. 8 to 12 inclusive;
- sec. 13, $NW\frac{1}{4}NE\frac{1}{4}$, $NW\frac{1}{4}$, $NW\frac{1}{4}SW\frac{1}{4}$;

T. 21 S., R. 32 E., (continued)

- secs. 14 to 20 inclusive;
- sec. 21, $N\frac{1}{2}$, $N\frac{1}{2}SW\frac{1}{4}$, $SW\frac{1}{4}SW\frac{1}{4}$;
- sec. 22, $N\frac{1}{2}NW\frac{1}{4}$, $SW\frac{1}{4}NW\frac{1}{4}$;
- sec. 26, $S\frac{1}{2}S\frac{1}{2}$;
- sec. 27, $SW\frac{1}{4}$, $S\frac{1}{2}SE\frac{1}{4}$;
- sec. 28, $SW\frac{1}{4}NE\frac{1}{4}$, $NW\frac{1}{4}NW\frac{1}{4}$, $S\frac{1}{2}NW\frac{1}{4}$, $N\frac{1}{2}S\frac{1}{2}$;
- secs. 29 to 31 inclusive;
- sec. 32, $NW\frac{1}{4}NE\frac{1}{4}$, $NW\frac{1}{4}$, $NW\frac{1}{4}SW\frac{1}{4}$;
- sec. 34, $N\frac{1}{2}NE\frac{1}{4}$;
- sec. 35, $N\frac{1}{2}N\frac{1}{2}$;
- sec. 36, $NW\frac{1}{4}NW\frac{1}{4}$, $SE\frac{1}{4}NW\frac{1}{4}$, $NE\frac{1}{4}SW\frac{1}{4}$, $W\frac{1}{2}SE\frac{1}{4}$, $SE\frac{1}{4}SE\frac{1}{4}$.

T. 21 S., R. 33 E.,

- sec. 1, lots 2 to 7 inclusive, 10 to 14 inclusive, $N\frac{1}{2}SW\frac{1}{4}$, $SW\frac{1}{4}SW\frac{1}{4}$;
- sec. 2, lots 1, 2, 6 to 16 inclusive, $S\frac{1}{2}$;
- sec. 3, lot 16, $E\frac{1}{2}SW\frac{1}{4}$;
- sec. 5, lots 2 to 7 inclusive, 10 to 14 inclusive, $NW\frac{1}{4}SW\frac{1}{4}$;
- sec. 6;
- sec. 7, lots 1 to 3 inclusive, $NW\frac{1}{4}NE\frac{1}{4}$, $E\frac{1}{2}NW\frac{1}{4}$;
- sec. 10, $E\frac{1}{2}$;
- sec. 11;
- sec. 12, $NW\frac{1}{4}NW\frac{1}{4}$, $SW\frac{1}{4}SW\frac{1}{4}$;
- sec. 13, $N\frac{1}{2}NW\frac{1}{4}$;
- sec. 14, $N\frac{1}{2}N\frac{1}{2}$;
- sec. 15, $NE\frac{1}{4}NE\frac{1}{4}$;
- sec. 25, $SE\frac{1}{4}NE\frac{1}{4}$, $S\frac{1}{2}SW\frac{1}{4}$, $NW\frac{1}{4}SE\frac{1}{4}$;
- sec. 31, lot 4, $SE\frac{1}{4}SW\frac{1}{4}$, $W\frac{1}{2}SE\frac{1}{4}$, $NE\frac{1}{4}SE\frac{1}{4}$;
- sec. 32, $NW\frac{1}{4}SW\frac{1}{4}$.

T. 21 S., R. 34 E.,

- sec. 17, $E\frac{1}{2}W\frac{1}{2}$, $NW\frac{1}{4}NW\frac{1}{4}$;
- sec. 18, lot 1, $N\frac{1}{2}NE\frac{1}{4}$, $NE\frac{1}{4}NW\frac{1}{4}$;
- sec. 19, $SE\frac{1}{4}NE\frac{1}{4}$, $N\frac{1}{2}SE\frac{1}{4}$, $SW\frac{1}{4}SE\frac{1}{4}$;
- sec. 20, $NW\frac{1}{4}NW\frac{1}{4}$;
- sec. 30, lot 2, $NE\frac{1}{4}NW\frac{1}{4}$.

T. 22 S., R. 28 E.,

- sec. 36, $E\frac{1}{2}E\frac{1}{2}$.

T. 22 S., R. 29 E.,

- sec. 17, $S\frac{1}{2}SE\frac{1}{4}$;
- sec. 19, $E\frac{1}{2}SE\frac{1}{4}$;
- sec. 29, $NW\frac{1}{4}NE\frac{1}{4}$, $N\frac{1}{2}NW\frac{1}{4}$;
- sec. 30, $NE\frac{1}{4}NE\frac{1}{4}$;
- sec. 31, lots 1 to 4 inclusive, $S\frac{1}{2}NE\frac{1}{4}$, $E\frac{1}{2}W\frac{1}{2}$, $SE\frac{1}{4}$;
- sec. 32, $W\frac{1}{2}NE\frac{1}{4}$, $W\frac{1}{2}$, $SE\frac{1}{4}$;
- sec. 33, $SW\frac{1}{4}SW\frac{1}{4}$.

T. 22 S., R. 30 E.,

- sec. 25, $NE\frac{1}{4}NE\frac{1}{4}$;
- sec. 36, $W\frac{1}{2}E\frac{1}{2}$.

T. 22 S., R. 31 E.,

- secs. 1 and 2;
- sec. 3, lots 1 to 4 inclusive, $S\frac{1}{2}N\frac{1}{2}$, $NE\frac{1}{4}SW\frac{1}{4}$, $SE\frac{1}{4}$;
- sec. 4, lots 1 to 4 inclusive;
- sec. 5, lots 1 to 4 inclusive;
- sec. 6, lot 1;
- sec. 10, $E\frac{1}{2}$;
- sec. 11;
- sec. 12, $NW\frac{1}{4}NE\frac{1}{4}$, $NW\frac{1}{4}$, $NW\frac{1}{4}SW\frac{1}{4}$;
- sec. 14, $NW\frac{1}{4}NE\frac{1}{4}$, $NW\frac{1}{4}$, $NW\frac{1}{4}SW\frac{1}{4}$;
- sec. 15, $E\frac{1}{2}$;
- sec. 16, $SW\frac{1}{4}$;
- sec. 17, $NW\frac{1}{4}SW\frac{1}{4}$, $N\frac{1}{2}SE\frac{1}{4}$;
- sec. 19, $E\frac{1}{2}E\frac{1}{2}$;
- sec. 21, $SW\frac{1}{4}NE\frac{1}{4}$, $NE\frac{1}{4}NW\frac{1}{4}$;
- sec. 22, $N\frac{1}{2}NE\frac{1}{4}$, $SW\frac{1}{4}NE\frac{1}{4}$, $SE\frac{1}{4}NW\frac{1}{4}$;
- sec. 30, lot 1, $NW\frac{1}{4}NE\frac{1}{4}$, $NE\frac{1}{4}NW\frac{1}{4}$.

T. 22 S., R. 32 E.,

- sec. 1, lot 1;
- sec. 6, lots 2 to 7 inclusive, $SE\frac{1}{4}NW\frac{1}{4}$.

T. 22 S., R. 33 E.,

- sec. 6, lot 4.

T. 23 S., R. 28 E.,

- sec. 1, lot 1.

T. 23 S., R. 29 E.,

- sec. 4, lots 3 and 4, $SW\frac{1}{4}NW\frac{1}{4}$;
- sec. 5, lots 1 to 4 inclusive, $S\frac{1}{2}N\frac{1}{2}$, $N\frac{1}{2}S\frac{1}{2}$, $S\frac{1}{2}SW\frac{1}{4}$, $SW\frac{1}{4}SE\frac{1}{4}$;
- sec. 6, lots 1 to 6 inclusive, $S\frac{1}{2}NE\frac{1}{4}$, $SE\frac{1}{4}NW\frac{1}{4}$, $E\frac{1}{2}SW\frac{1}{4}$, $SE\frac{1}{4}$;
- sec. 7, $NE\frac{1}{4}$, $NE\frac{1}{4}NW\frac{1}{4}$;
- sec. 8, $W\frac{1}{2}NE\frac{1}{4}$, $NW\frac{1}{4}$, $N\frac{1}{2}SW\frac{1}{4}$, $SE\frac{1}{4}SW\frac{1}{4}$, $SE\frac{1}{4}$;
- sec. 9, $E\frac{1}{2}NE\frac{1}{4}$, $SW\frac{1}{4}NE\frac{1}{4}$, $SE\frac{1}{4}NW\frac{1}{4}$, $S\frac{1}{2}$;
- sec. 15, $W\frac{1}{2}SW\frac{1}{4}$;
- sec. 16;
- sec. 17, $NE\frac{1}{4}$, $E\frac{1}{2}SE\frac{1}{4}$;
- sec. 21, $N\frac{1}{2}$, $N\frac{1}{2}S\frac{1}{2}$, $S\frac{1}{2}SW\frac{1}{4}$;
- sec. 22, $W\frac{1}{2}NW\frac{1}{4}$;
- sec. 24, $NE\frac{1}{4}SE\frac{1}{4}$;
- sec. 25, $W\frac{1}{2}NW\frac{1}{4}$, $NW\frac{1}{4}SW\frac{1}{4}$;
- sec. 27, $SW\frac{1}{4}$, $W\frac{1}{2}SE\frac{1}{4}$, $SE\frac{1}{4}SE\frac{1}{4}$;
- sec. 28, $W\frac{1}{2}NW\frac{1}{4}$, $N\frac{1}{2}S\frac{1}{2}$, $SE\frac{1}{4}SE\frac{1}{4}$;
- sec. 33, $NE\frac{1}{4}NE\frac{1}{4}$;
- sec. 34, $W\frac{1}{2}NE\frac{1}{4}$, $N\frac{1}{2}NW\frac{1}{4}$, $SE\frac{1}{4}NW\frac{1}{4}$, $NE\frac{1}{4}SW\frac{1}{4}$, $W\frac{1}{2}SE\frac{1}{4}$, $SE\frac{1}{4}SE\frac{1}{4}$;
- sec. 35, $S\frac{1}{2}S\frac{1}{2}$, $NE\frac{1}{4}SE\frac{1}{4}$;
- sec. 36, $W\frac{1}{2}NE\frac{1}{4}$, $N\frac{1}{2}NW\frac{1}{4}$, $NW\frac{1}{4}SW\frac{1}{4}$.

T. 23 S., R. 30 E.,

- sec. 1, lot 3, $SE\frac{1}{4}SW\frac{1}{4}$, $S\frac{1}{2}SE\frac{1}{4}$;
- sec. 8, $SW\frac{1}{4}NE\frac{1}{4}$, $S\frac{1}{2}NW\frac{1}{4}$, $S\frac{1}{2}$;
- sec. 17;
- sec. 19, lot 3, $E\frac{1}{2}$, $SE\frac{1}{4}NW\frac{1}{4}$, $E\frac{1}{2}SW\frac{1}{4}$;
- sec. 20;

T. 23 S., R. 30 E., (continued)

- sec. 21, $S\frac{1}{2}NW\frac{1}{4}$, $SW\frac{1}{4}$, $SW\frac{1}{4}SE\frac{1}{4}$;
- sec. 22, $N\frac{1}{2}SW\frac{1}{4}$, $SE\frac{1}{4}SE\frac{1}{4}$;
- sec. 23, $E\frac{1}{2}$, $S\frac{1}{2}SW\frac{1}{4}$;
- sec. 24, $NW\frac{1}{4}$, $NW\frac{1}{4}SW\frac{1}{4}$;
- sec. 26, $N\frac{1}{2}NE\frac{1}{4}$, $SW\frac{1}{4}NE\frac{1}{4}$, $SE\frac{1}{4}NW\frac{1}{4}$, $SW\frac{1}{4}$, $W\frac{1}{2}SE\frac{1}{4}$;
- sec. 27, $SE\frac{1}{4}SW\frac{1}{4}$, $S\frac{1}{2}SE\frac{1}{4}$, $NE\frac{1}{4}SE\frac{1}{4}$;
- sec. 28, $NW\frac{1}{4}NE\frac{1}{4}$, $NW\frac{1}{4}$, $NW\frac{1}{4}SW\frac{1}{4}$;
- sec. 29, $NE\frac{1}{4}$, $N\frac{1}{2}NW\frac{1}{4}$, $SE\frac{1}{4}NW\frac{1}{4}$, $N\frac{1}{2}SE\frac{1}{4}$;
- sec. 33, $SE\frac{1}{4}NE\frac{1}{4}$, $S\frac{1}{2}SE\frac{1}{4}$, $NE\frac{1}{4}SE\frac{1}{4}$;
- sec. 34;
- sec. 35, $W\frac{1}{2}$.

T. 23 S., R. 31 E.,

- sec. 6, lot 7;
- sec. 7, $SW\frac{1}{4}NE\frac{1}{4}$, $W\frac{1}{2}SE\frac{1}{4}$;
- sec. 10, $SE\frac{1}{4}SE\frac{1}{4}$;
- sec. 11, $S\frac{1}{2}NE\frac{1}{4}$, $S\frac{1}{2}SW\frac{1}{4}$, $SE\frac{1}{4}$;
- sec. 12, $SW\frac{1}{4}NW\frac{1}{4}$, $SW\frac{1}{4}$;
- sec. 13, $SW\frac{1}{4}NE\frac{1}{4}$, $W\frac{1}{2}$, $W\frac{1}{2}SE\frac{1}{4}$;
- sec. 14, $N\frac{1}{2}N\frac{1}{2}$, $SE\frac{1}{4}SE\frac{1}{4}$;
- sec. 15, $NE\frac{1}{4}NE\frac{1}{4}$, $W\frac{1}{2}NE\frac{1}{4}$, $SE\frac{1}{4}NW\frac{1}{4}$, $N\frac{1}{2}SW\frac{1}{4}$;
- sec. 16, $N\frac{1}{2}SW\frac{1}{4}$;
- sec. 17, $S\frac{1}{2}SW\frac{1}{4}$, $N\frac{1}{2}SE\frac{1}{4}$;
- sec. 18, $W\frac{1}{2}NE\frac{1}{4}$, $N\frac{1}{2}SE\frac{1}{4}$, $SE\frac{1}{4}SE\frac{1}{4}$;
- sec. 22, $SE\frac{1}{4}SE\frac{1}{4}$;
- sec. 23, $E\frac{1}{2}$, $SE\frac{1}{4}NW\frac{1}{4}$, $SW\frac{1}{4}$;
- sec. 24, $W\frac{1}{2}NE\frac{1}{4}$, $W\frac{1}{2}$;
- sec. 25, $W\frac{1}{2}NE\frac{1}{4}$, $NW\frac{1}{4}$, $N\frac{1}{2}SW\frac{1}{4}$, $NW\frac{1}{4}SE\frac{1}{4}$;
- sec. 26;
- sec. 27, $E\frac{1}{2}$;
- sec. 34, $E\frac{1}{2}$;
- sec. 35, $NE\frac{1}{4}NW\frac{1}{4}$, $W\frac{1}{2}NW\frac{1}{4}$.

T. 24 S., R. 29 E.,

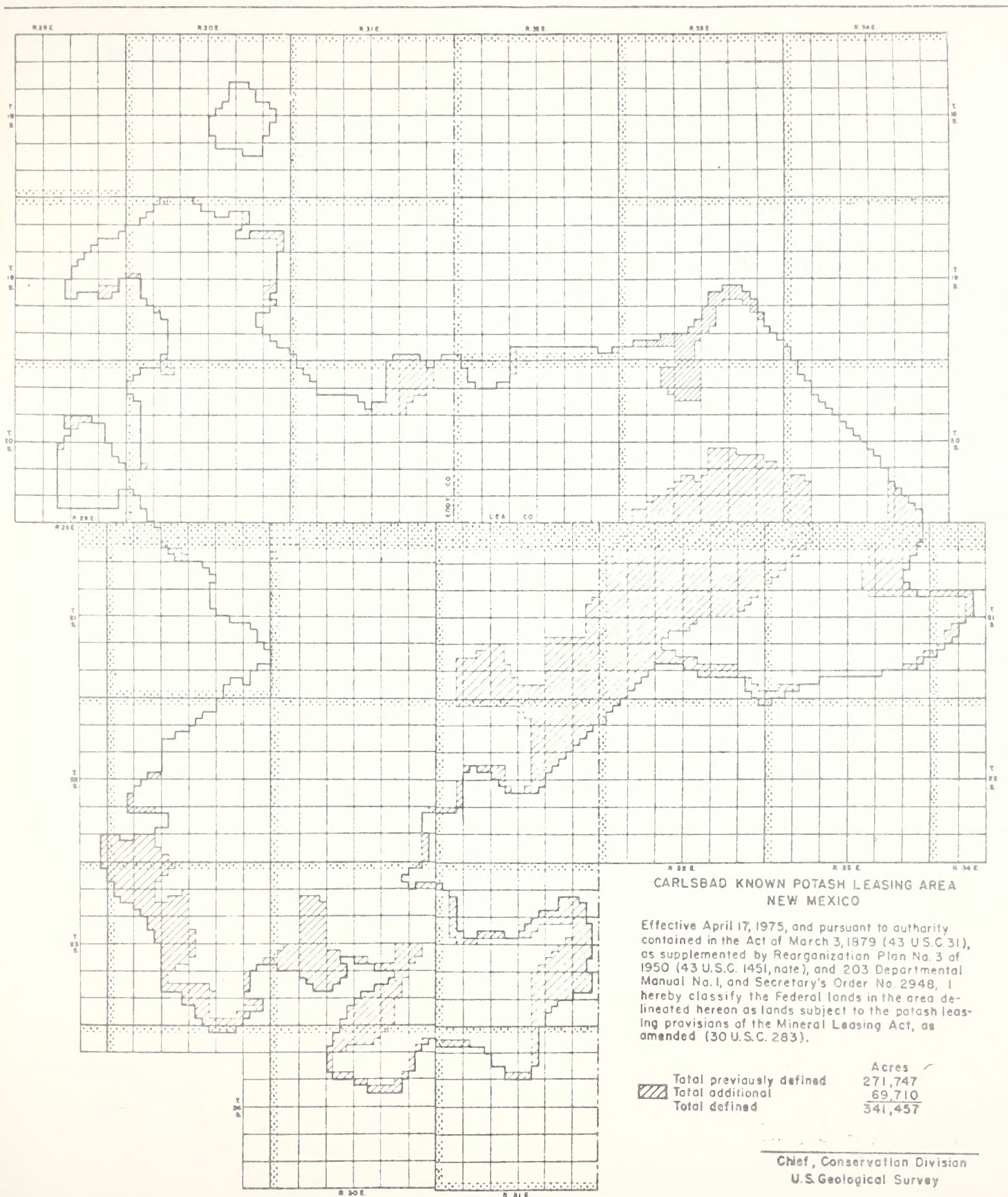
- sec. 2, lots 2 to 4 inclusive;
- sec. 3, lot 1.

T. 24 S., R. 30 E.,

- sec. 1, $SE\frac{1}{4}SW\frac{1}{4}$, $NW\frac{1}{4}SE\frac{1}{4}$;
- sec. 2, lot 4;
- sec. 3, lots 1 to 4 inclusive, $S\frac{1}{2}N\frac{1}{2}$, $N\frac{1}{2}SW\frac{1}{4}$, $NW\frac{1}{4}SE\frac{1}{4}$;
- sec. 4, lots 1 and 2, $S\frac{1}{2}NE\frac{1}{4}$, $SE\frac{1}{4}NW\frac{1}{4}$, $S\frac{1}{2}SW\frac{1}{4}$, $NE\frac{1}{4}SW\frac{1}{4}$, $W\frac{1}{2}SE\frac{1}{4}$, $NE\frac{1}{4}SE\frac{1}{4}$;
- sec. 9, $W\frac{1}{2}NW\frac{1}{4}$, $NW\frac{1}{4}SW\frac{1}{4}$, $SE\frac{1}{4}SW\frac{1}{4}$, $S\frac{1}{2}SE\frac{1}{4}$;
- sec. 11, $SE\frac{1}{4}SE\frac{1}{4}$;
- sec. 12, $W\frac{1}{2}NW\frac{1}{4}$, $NW\frac{1}{4}SW\frac{1}{4}$;
- sec. 14, $W\frac{1}{2}NE\frac{1}{4}$, $S\frac{1}{2}NW\frac{1}{4}$;
- sec. 15, $S\frac{1}{2}NE\frac{1}{4}$, $N\frac{1}{2}NW\frac{1}{4}$.

T. 24 S., R. 31 E.,

- sec. 3, lot 2, $SW\frac{1}{4}NE\frac{1}{4}$, $W\frac{1}{2}SE\frac{1}{4}$;
- sec. 5, $NW\frac{1}{4}SW\frac{1}{4}$;
- sec. 6, lot 6, $NE\frac{1}{4}SW\frac{1}{4}$, $N\frac{1}{2}SE\frac{1}{4}$;
- sec. 9, $S\frac{1}{2}SE\frac{1}{4}$;
- sec. 10, $W\frac{1}{2}NE\frac{1}{4}$, $S\frac{1}{2}SW\frac{1}{4}$.



Appendix A-8

Soil Groupings - Potash Area

The following are minor text changes to this appendix:

Original text on second page, last paragraph states:

A typical profile of this grouping is as follows:

This should be corrected to read:

A typical profile of a Kimbrough Series, a member of this grouping, is as follows:

Original text on sixth page, second paragraph states:

A typical profile of this grouping is as follows:

This should be corrected to read:

A typical profile of a Cottonwood Reeves Series, a member of this grouping, is as follows:

On the sixth page, the following paragraph should be added following the second paragraph.

A12-1 to 5 inches, light brownish gray (10YR 6/2) loam, brown (10YR 5/2) when moist; massive, soft when dry, friable when moist; non-sticky when wet; common prominent lime mycalici, slightly to strongly calcareous; neutral to mildly alkaline; gradual, smooth boundary.

Original text on tenth page, third paragraph states:

A typical profile of this grouping is as follows:

This should be corrected to read:

A typical profile of a Berino Series, a member of this grouping, is as follows:

Original text on fourteenth page, second paragraph states:

A typical profile is as follows:

This should be corrected to read:

A typical profile of a Largo Series, a member of this grouping, is as follows:

Original text on eighteenth page, second paragraph states:

A typical profile of this unit is found below:

This should be corrected to read:

A typical profile of a Midessa Series, a member of this grouping is as follows:

Appendix B

Living Components

The scientific names of all items listed in this appendix should have been printed in italic style type.

The sources for the scientific names are:

Birds

Robbins, Chandler S., Bertel Brunn, and Herbert S. Zim. Birds of North America. Golden Press, New York. 1966.

Mammals

Burt, William H. and Richard Grossenheider. A Field Guide to the Mammals. Houghton Mifflin Co., Boston. 1952.

Reptiles and Amphibians

Stebbins, Robert C. A Field Guide to Western Reptiles and Amphibians. Houghton Mifflin Co., Boston. 1966.

Bibliography

The following changes should be made in the bibliography.

Fritz, and Fritz (1948) Evidence of Folsom Culture in the Sand Dunes of Western Texas. Texas Archaeological Society Bulletin 12.

Harris, Arthur. 1970. The dry land mammalian fauna and late pluvial conditions in southeastern New Mexico. Texas Journal of Science. XXII No. 1.

Lea County Archaeological Society. The Laguna Plata site LCAS C-10-6 LA 5148. Lea County Archaeological Society, Inc.

Glossary

The following changes should be made in the glossary.

Archaeological Sites. Evidences of past human occupation which can be used to reconstruct the lifeways of past peoples. Archaeological sites usually date from prehistoric or aboriginal periods.

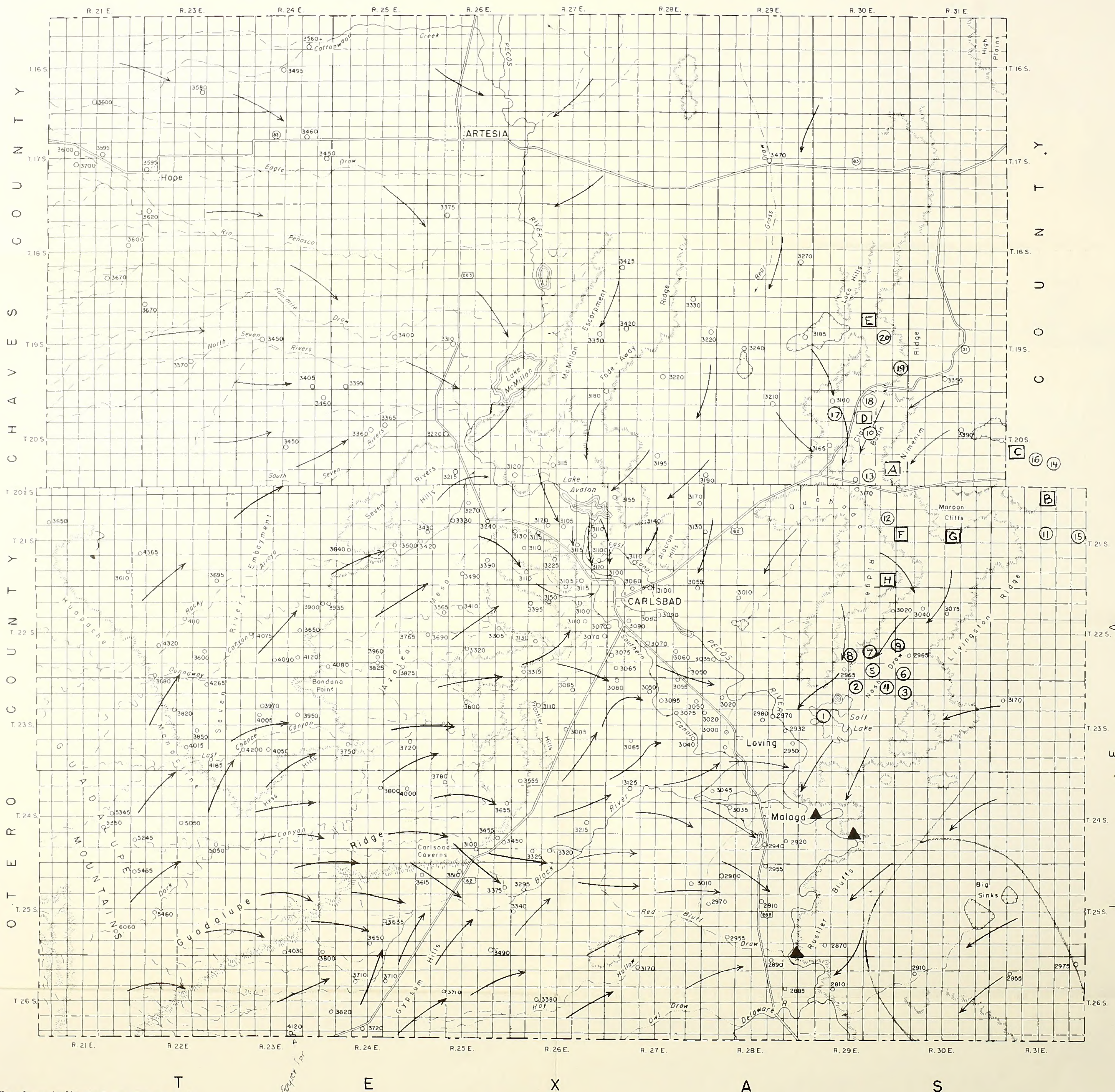
Coulomb's law. A statement in physics: the force of attraction or repulsion acting along a straight line between two electric charges or two magnetic poles is directly proportional to the product of the charges or pole strengths and inversely to the square of the distance between them.

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C H A V E S C O U N T Y



The data indicated in the legend has been placed on the map by BLM.

LEGEND

- | | |
|------------------------------|------------------------|
| ○ Brine Ponds & Lakes | ▲ USGS Gaging Stations |
| 1. Laguna Grande de Sal | 11. Kerr-McGee Ponds |
| 2. Laguna Cinco | 12. MCC Ponds |
| 3. Laguna Quatro & Nash Well | 13. Duval Ponds |
| 4. Laguna Tres | 14. Laguna Toston |
| 5. Laguna Seis | 15. Williams Lake |
| 6. Laguna Dos | 16. National Ponds |
| 7. Tamarisk Lake | 17. PCA Ponds |
| 8. Lindsey Lake | 18. Clayton Lake |
| 9. Laguna Uno | 19. Hackberry Lake |
| 10. Laguna Siete | 20. Amax Ponds |

Location of Lakes and Ponds from Aerial Photographs, May 20, 1975.

GENERAL DIRECTION OF MOVEMENT OF GROUND WATER IN EDDY COUNTY, NEW MEXICO

SCALE 0 5 10 MILES

EXPLANATION

- | | |
|--|----------|
| ○ Well | Q Spring |
| → Direction of ground water movements | |
| 3380 Altitudes (feet above sea level) of ground water levels | |

Base map is from Hendrickson and Jones, Geology and Ground-water Resources of Eddy County, New Mexico, 1952. The New Mexico Bureau of Mines and Mineral Resources.

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